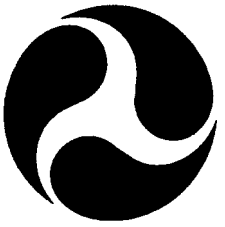
FAA-E-2835
April 14,1989



U.S. Department of Transportation

Federal Aviation Administration

Specification

ENVIRONMENTAL REMOTE MONITORING SUBSYSTEM (ERMS)

(RETROFIT FACILITIES ONLY)

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APPENDICES

1. Scope. This specification establishes the Federal Aviation Administration's (FAA's) functional, performance, interface, development, and installation requirements for the retrofit of environmental remote monitoring subsystems (ERMS) at selected National Airspace System (NAS) facilities.

1.1. Purpose. It is intended that the ERMS shall be a stand-alone RMMS consisting of hardware and software, suitable for retrofit into existing NAS facilities, to monitor and control the environmental equipment installed within these facilities. The facility environmental equipment includes electrical power systems, environmental conditioning systems, smoke and fire detection systems, and security and safety systems. The ERMS shall accomplish its functions through the use of computer hardware and software, sensors, and data communications systems. The installed ERMS will improve safety, the availability of equipment and services, and the cost effectiveness of NAS facilities maintenance. The ERMS will provide for more effective utilization of human resources, improved span of control, and structured maintenance levels (i.e., system, restoration, repair), and will support such ongoing and future intra-administration programs as the FAA's Airway Facilities (AF) and General NAS Sector (GNAS) management.

1.2. Introduction. The ERMS, as specified herein, will meet all functional, performance, hardware, software, and interface requirements necessary to monitor and control NAS facility environmental equipment. The ERMS is supported by the Maintenance Processor Subsystem (MPS) as the primary processor (highest level) of the Remote Maintenance Monitoring System (RMMS). The MPS is the central manager for the real-time monitoring and control of NAS facilities subsystems/equipment and provides the interface between the remote monitoring subsystems (RMSs), such as ERMS, and other elements of the RMMS. The physical implementation of the ERMS is obtained primarily through the use of a microprocessor based industrial control system henceforth referred to as a cell controller. Selected NAS facilities shall be retrofitted with appropriately configured ERMSs to perform the required monitoring and control functions.

2. Applicable Documents

2.1. Government Documents The following Government publications of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

SPECIFICATIONS:

FAA

FAA-C-1217 Electrical Work, Interior

FAA-D-2494	Instruction Book Manuscript: Electric, Electrical, and Mechanical Equipment
FAA-E-2738	Radio Control Equipment (RCE)
FAA-E-2782	Remote Maintenance Monitoring Subsystem Core System/Segment Specification
FAA-G-1375	Spare Parts-Peculiar for Electronic, Electrical and Mechanical Equipment
FAA-G-2100	Electronic Equipment, General Requirements

STANDARDS

FAA

FAA-STD-002	Facilities Engineering Drawing Preparation
FAA-STD-005	Preparation of Specification Documents
FAA-STD-012	Paint Systems for Equipment
FAA-STD-020	Transient Protection, Grounding, Bounding, and Shielding Requirements for Equipment
FAA-STD-021	Configuration Management, Contractor Requirements
FAA-STD-024	Preparation of Test and Evaluation Documentation
FAA-STD-025	Preparation of Interface Control Documents
FAA-STD-026	NAS Software Development
FAA-STD-028	Contract Training Programs

Military

DOD-STD-100	Engineering Drawing Practices
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for Control of Electromagnetic Interference
MIL-STD-471	Maintainability Verification / Demonstration / Evaluation

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EIA

RS-232	Interface between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange
RS-310	Racks, Panels, and Associated Equipment.

NEMA

PE 1-1983	Uninterruptible Power Systems.
ICS 6-1983	Enclosures for Industrial Controls and Systems

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owned communications facilities, through a remote monitoring subsystem concentrator (RMSC), or for suitably equipped remote radio sites, through a radio control equipment (RCE) channel.

b. In the secondary (local) mode of operation, the ERMS shall [1] provide its operational functions to both the MPS, as described above, and via an I/O port to a PMDT. In this mode of operation, however, the existence of a connected and operational PMDT, through a change-of-state message, will cause the disabling (lock-out) of all environmental equipment control functions from the MPS location< All other operational monitoring functions shall [2] be provided in parallel at both the PMDT and the MPS locations.

3.1.1.2. System Interfaces. The ERMS shall [1] exist in one physical state having four data interfaces, and two power system interfaces:

a. Interface 1 shall [2] provide I/O service to the MPS processors and shall [3] conform to the communications protocol referenced in Appendix IA

b. Interface 2 shall [4] provide I/O service to the PMDT and shall [5] conform to the communications protocol referenced in Appendix IA.

c. Interface 3 shall [6] provide I/O service to the local environmental equipment sensors and control mechanisms.

d. Interface 4 shall [7] provide I/O service to a remote engine generator (E/G) unit with remote I/O controller, remote environmental equipment sensors, and remote control mechanisms.

e. The ERMS external power interface shall [8] provide 120Vac at 20 amperes to the uninterruptable power supply (UPS).

f. The ERMS remote external power interface shall [9] provide 120Vac at 20 amperes to the remote UPS.

3.1.2. ERMS Functions. The ERMS shall provide broad operational functions that consist of the parametric monitoring and control of electrical power systems, environmental conditioning systems, smoke and fire detection systems and security access systems (see Figure 1). The following are ERMS functional requirements:

3.1.2.1. Environmental Equipment Status and Performance Monitoring. The ERMS shall obtain facility environmental equipment status and performance data from the monitored equipment as specified in this section.

3.1.2.1.1. Real-Time Monitoring. The ERMS shall monitor facility environmental equipment performance in real time by use of on-line monitors (hardware sensors) and in-line monitors (software sensors).

3.1.2.1.2. Local Data File. The ERMS shall automatically accumulate ERMS status, performance, and performance analysis data in a local data file.

3.1.2.1.3. Data Report. The ERMS shall provide data in response to a request from the MPS or PMDT.

3.1.2.1.4. Operating Status. The ERMS shall obtain operating status data from the facility environmental equipment that includes configuration and mode of operation.

3.1.2.1.5. Subsystem Status Response. The ERMS shall report state changes and alarms and alerts in response to status requests from the MPS or PMDT.

3.1.2.1.6. Subsystem Alarm Generation. The ERMS shall generate an alarm when any monitored parameter of any facility environmental equipment exceeds the predetermined alarm threshold or when smoke, fire, or physical intrusion into a facility has occurred.

3.1.2.1.7. Subsystem Alert Generation. The ERMS shall generate an alert when selected parameter measurements are outside predetermined alert threshold ranges.

3.1.2.1.8. Return-to-Normal Message. The ERMS shall generate a return-to-normal message when an initial alarm or alert condition is cleared, i.e., when system parameter(s) return to within specified limits.

3.1.2.1.9. Alarm and Alert Parameters. The ERMS shall provide the means to accept upper and lower thresholds for alarm and alert parameters.

3.1.2.1.10. Alarm and Alert Disabling. The ERMS shall [1] provide for the disabling of an alarm or alert by a specialist on site. This action shall [2] only inhibit alarms or alerts generated at the specific facility.

3.1.2.1.11. Alarm and Alert Disable Report. The ERMS shall report the disabling of an alarm or alert as performance data.

3.1.2.1.12. ERMS Facility Data Analyses. The ERMS shall provide values, derived from historical (stored) sensor input data, that relate to the performance of facility environmental equipment including electrical power systems, heating, ventilation, and air conditioning (HVAC) systems, security and intrusion systems and fire and smoke detection systems.

3.1.2.1.13. Control Commands. The ERMS shall receive and execute facility environmental equipment control commands.

3.1.2.1.14. Operating Status Control. The ERMS shall provide the means to remotely change (control) the operating status of the E/G, heating, ventilating, air conditioning, and HVAC units, from one operating status to any other operating status.

3.1.2.1.15. Parameter Adjustment. The ERMS shall provide for adjustment via software of all equipment monitoring parameters including alarm and alert thresholds and delay times, confidence count values, and sensor input scaling and offsetting values.

3.1.2.1.16. Reset. The ERMS shall [1] provide the means to remotely reset environmental equipment that is not safety locked out to enable restoration of service. The ERMS shall [2] itself be resettable and shall [3], when so directed, report the contents of the status and alarm file as it was immediately prior to its being reset.

3.1.2.1.17. Fault Isolation. The ERMS shall provide the means to determine and report, as a single comprehensive output, the operational status of all environmental equipment to which it is attached and to report a fault diagnosis for each sensed equipment parameter in an alarm or alert status.

3.1.2.1.18. Specialist Access. The ERMS shall provide specialist access to the RMMS network via the PMDT interface.

3.1.2.1.19. Data Input/Output Display. The ERMS shall [1] provide for local input and display of commands and data via the portable

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ERMS SYSTEM FUNCTIONAL RELATIONSHIPS AND SCAN CYCLE BY FUNCTION

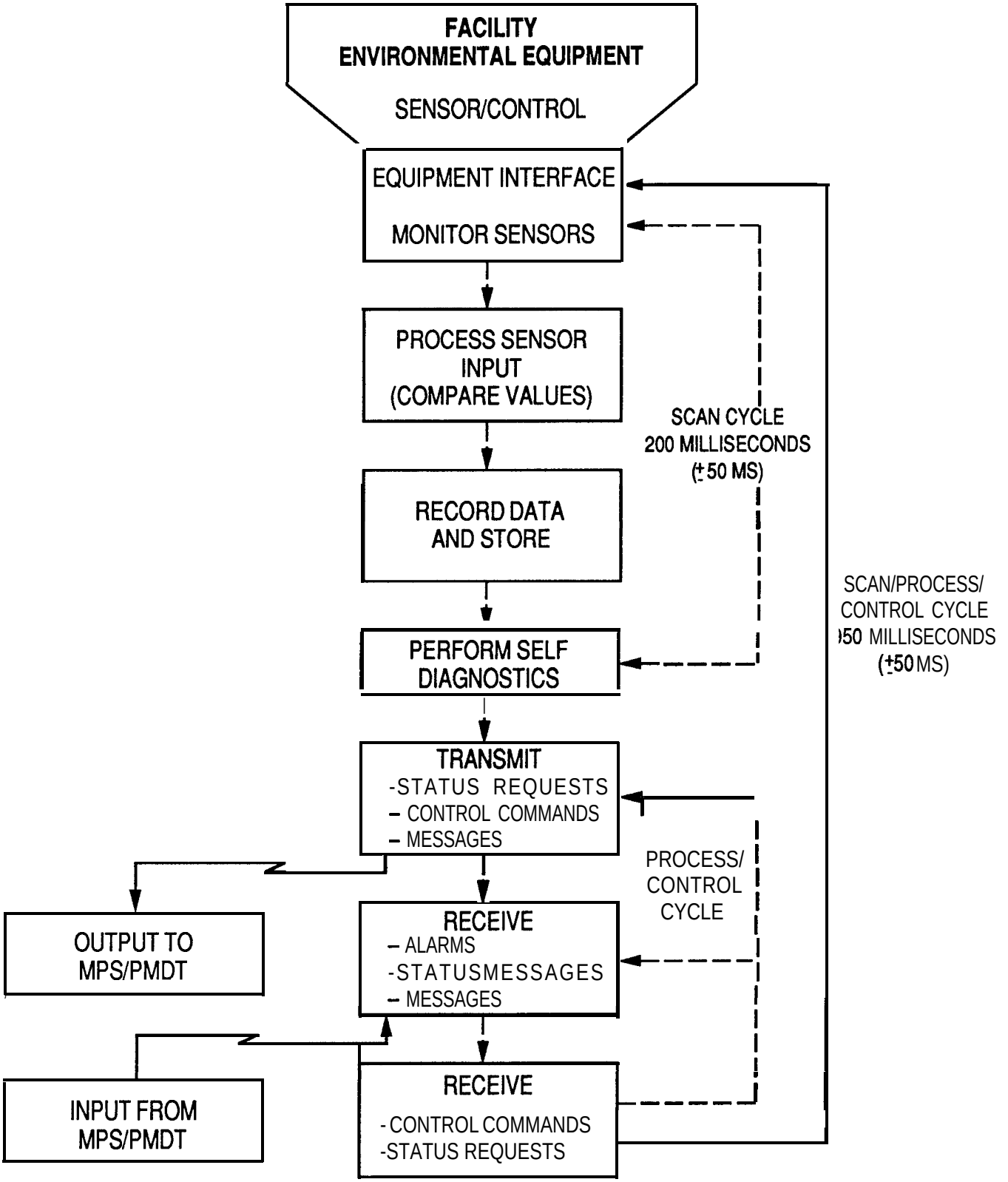

FIGURE 1

ERMS SYSTEM FUNCTIONAL RELATIONSHIPS AND SCAN CYCLE BY FUNCTION

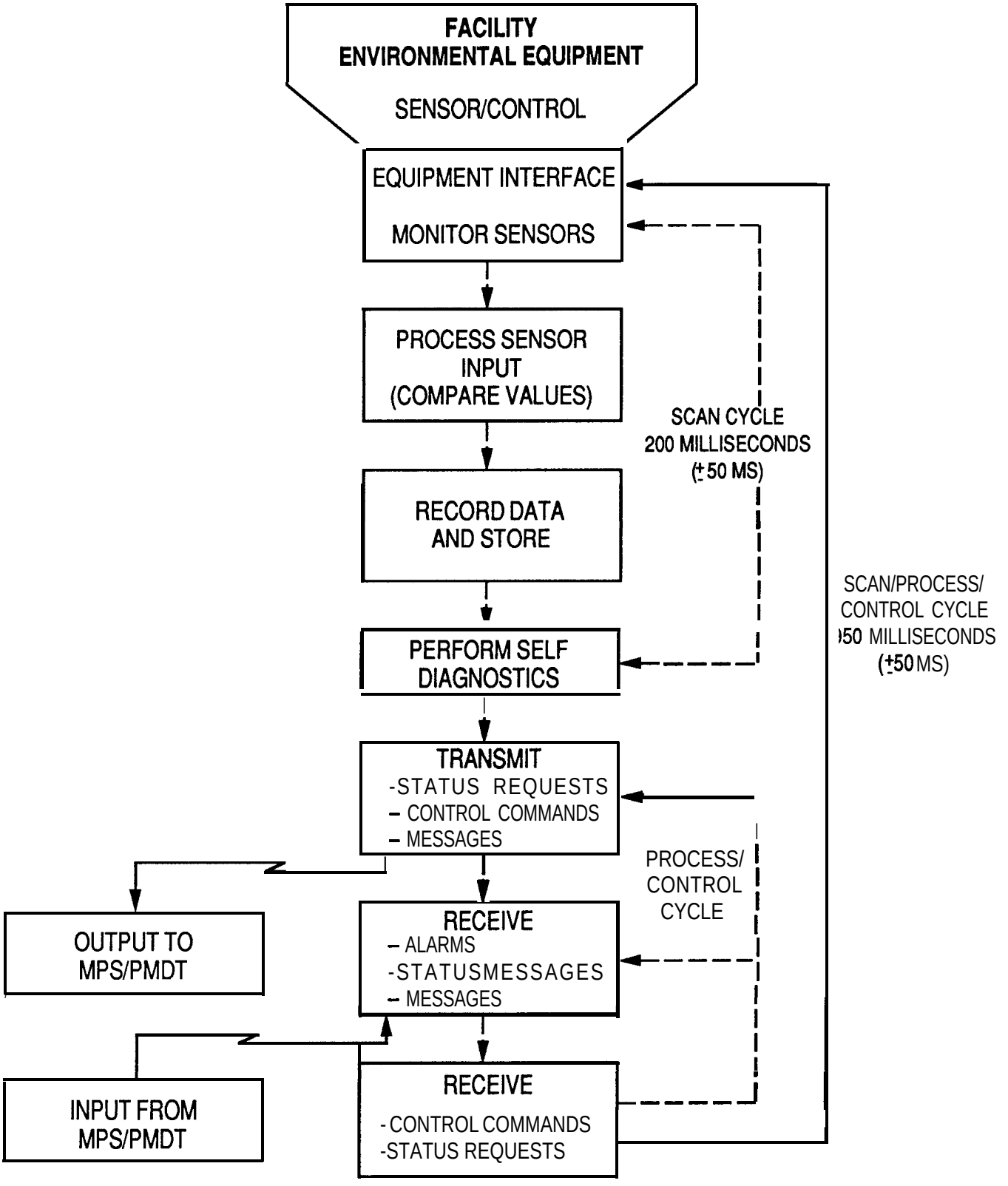

FIGURE 1

3.1.4. Configuration Allocation:

a. Hardware Configuration Requirements. The ERMS shall conform to the following general hardware configuration requirements.

1. The ERMS shall provide its defined operational functions without consideration for and independent of facility site-particular and environmental equipment configurations.

2. The ERMS shall be installed to interface with MPS equipment meeting Appendix IA data communications protocol requirements. Alternatively, the ERMS may interface to a radio control equipment (RCE) channel whose characteristics are defined in FAA-E-2738.

3. The ERMS "cell controller" concept and design shall be based upon expandable, interchangeable, rack-mounted "building blocks" that consist of microprocessor(s), I/O processors, interfaces, and memory modules.

4. ERMS modules shall be installable without regard for physical positioning of modules relative to each other within the facility.

5. The ERMS shall accommodate variations in quantities and types of hardware modules, sensors, interfaces and parametric (software) applications as they are needed within the limits subsequently to be defined in Section 3.2 of this specification.

6. The ERMS shall operate for a minimum of two (2) hours during facility power failure.

b. Software Configuration Requirements. The ERMS shall conform to the following general software configuration requirements:

1. ERMS screen presentations shall [1] be resident as software on the PMDT and shall [2] utilize data provided by the ERMS Cell Controller for display within the presentation screen format. The ERMS shall [3] be operable using a PMDT without reference to printed documentation. Each data screen shall [4] allow selection of a corresponding "help" screen fully explaining all screen functions (see Appendix II).

2. The ERMS software design shall be modular with each module limited in size to 300 lines of program code.

3. The ERMS shall [1] allow for software installation and maintenance at any installed facility. Software shall [2] be loadable via MPS and via the PMDT.

4. The ERMS shall [1] support RMMS test functions and shall [2] automatically execute self-test functions.

5. The ERMS system interfacing, architecture, and communications protocols for the MPS shall [1] be developed according to the requirements of the references specified in Appendix IA. The PMDT interface shall [2] be developed according to the requirements of the references specified in Appendix IB. Interface control documents (ICDs) specifying ERMS implementation of these requirements shall [3] be prepared in accordance with FAA-STD-025, Preparation of Interface Control Documentation.

3.1.4.1. Hardware Configuration Items (HWCIs). The ERMS hardware configuration shall consist of the following major items (See Figure 2):

a. Cell controller: A microprocessor consisting of a central processing unit (CPU) or units; operating system, program, data, and utility memories (registers) (see Figure 3); auxiliary co-processors (e.g., math, terminal, data communications); clock(s) and timer(s); and I/O ports and interfaces as required to perform defined functions (see Figure 2).

b. Uninterruptible Power System (UPS), consisting of backup battery(s), inverter, and electrical power interfaces for at least two (2) hours of backup power.

c. Sensor Power supply and electrical power interface(s) to ERMS sensor/controller configuration items (ESCIs) requiring dc power.

d. ESCIs and interface(s) to cell controller interface 3 modules.

e. Data Communications controllers and interfaces to the RMMS network (Interface 1), to the PMDT (Interface 2) and to the remote sensor monitor and control modules (Interface 4).

The major items listed above are designated as hardware configuration items (HWCIs). The following two tables specify the limitations of the ERMS operating environment for HWCIs and ESCIs:

TABLE I
ERMS ENVIRONMENTAL CONDITIONS
FOR CONTINUOUS OPERATION

ENVIRON-MENT	TEMP °F	REL. HUM. °	ALTITUDE (ft MSL)	WIND (MPH)	ICE LOAD#
I	SEE TABLE IA	5 to 90	0 to 10K	N/A	N/A
II	SEE TABLE IA	5 to 100	0 to 10K	0 to 100	½"#
III	+14 to +113	5 to 90	0 to 10K		

I For ESCI components installed inside facility
II For ESCI components installed outdoors
III For HWCI components installed inside facility
Radial encasement

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management, fault isolation, device control and I/O processing. The cell controller shall [2] be a modular hardware system consisting of:

a. One or more (CPUs)

b. Memory module(s) (See Figure 3)

c. An I/O rack to contain discrete function I/O ports and interfaces

d. I/O ports (interfaces) consisting of:

1. Discrete ac and dc I/O modules (Interface 3)

2. Analog dc I/O modules (Interface 3)

3. RS-232 RMMS data communication module (Interface 1)

4. RS-232 PMDT communication module (Interface 2)

5. Remote E/G unit sensor module (Interface 4)

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3. RS-232 RMMS data communication module (Interface 1)

4. RS-232 PMDT communication module (Interface 2)

5. Remote E/G unit sensor module (Interface 4)

3.1.4.1.2. HWCI002 Uninterruptable Power Supply (UPS). A battery and inverter-operated ERMS UPS shall be installed to provide a minimum of two (2) hours of electrical power to the ERMS in the event of commercial and E/G power failure.

3.1.4.1.3. HWCI003 ESCI Low Voltage Power Supply. The ERMS shall [1] contain a dc power supply to supply the necessary operating voltage(s) as required to each ERMS sensor (see Figure 2). This power supply shall [2] be operated by facility power or, in the case of facility power supply failure, by the UPS (see Figure 2).

3.1.4.1.4. HWCI004 ESCIs, Switches, and Control Devices. The ERMS shall perform its monitoring, control, data storage, and analysis functions using information received from ESCIs (sensors, relays, switches), and external sources (MPS and PMDT) whose inputs are to be processed as defined in this specification. ESCIs and other input device specifications are provided in paragraph 3.2.3. Control functions and specifications are defined in Paragraph 3.2.4. ESCI definitions are provided in paragraph 3.1.4.3.

3.1.4.1.5. HWCI005 Remote E/G Unit ESCI Interface Module. Should the facility configuration require, the cell controller shall perform its E/G monitoring, control and data storage functions when its ESCIs are located on a remote E/G unit, i.e., a unit physically located up to 10,000 feet from the facility.

3.1.4.1.6. HWCI006 Data Communications Controller. All ERMS RMMS information transmitted or received shall [1] be managed through the use of a data communications interface (Interface 1) whose function shall [2] be to perform data input and output control as described in Appendix IA.

3.1.4.1.7. HWCI007 Portable Maintenance Data Terminal Interface. All ERMS cell controller functions shall [1] be accessible through the use of a PMDT. The PMDT shall [2] provide for input of local site adaptation parameters, henceforth to be referred to as ERMS facility-site generation (SITEGEN); provide for local facility ERMS monitor and control; provide for specialist data communication between the facility-site and the RMMS network; provide for loading of software into itself and into the cell controller; and provide for the execution of these functions through the use of full screen I/O presentation displays. The ERMS shall [3] communicate with the PMDT via Interface 2. Appendix IB provides the PMDT data communication protocol requirements (see also FAA-E-2782). A PMDT will be provided by the Government for use in interface testing and in developing the ERMS interface and screen presentation software.

3.1.4.2. Computer Software Configuration Items (CSCIs). The following CSCIs define and specify the ERMS software configuration requirements necessary to achieve ERMS functions.

3.1.4.2.1. CSCI001 Cell Controller Microprocessor Operating System(s). The microprocessor(s) and operating system(s) used to meet ERMS functional and performance requirements shall [1] be integral subelements of the cell controller. The cell controller microprocessor operating system shall [2] provide the multiuser, multitasking functions of: system security, supervisory control, self diagnostics, I/O processing, application program processing, memory management, and device control and coordination. The operating system shall [3] support high level programming languages including extended relay ladder logic ERLL and shall [4] be locally configurable to support from the minimum to the full range of ERMS operational functions.

3.1.4.2.2. CSCI002 Data I/O Management. The cell controller system shall [1] provide for storing and formatting for display, data containing alphanumeric characters from program variables, data storage files; ERLL timers, registers and counters; math functions; RMMS inputs; other program language applications; and analog functions. This data may be in the form of messages containing the full range of alphanumeric characters that shall [2] be formattable for display or hard copy output as required.

3.1.4.2.3. CSCI003 Data Communication and Multi-taskins Operations. The cell controller shall [1] perform, simultaneously, the following operations: background parametric monitoring, control, diagnostic, fault isolation, and data analysis; communications tasks in support of RMMS higher level processor(s) or local PMDT terminal requirements; foreground applications processing for command and control execution and for processing, display, and other output of information to the MPS or PMDT. (NOTE: The word "simultaneous" as used above encompasses the use of "time slicing" to accomplish simultaneous tasks using a single CPU.) The system shall [2] perform all data communications functions without interrupting the basic processes of subsystem monitoring and control by the cell controller.

3.1.4.2.4. CSCI004 Application Software Operations. The ERMS functions of remote monitoring; status and alarm and alert reporting; remote control; self diagnostics and fault isolation; on-line data recording; data management, analysis, and display; facility-site local (PMDT) access; and access control and security shall be developed and implemented as software applications to meet performance requirements as defined in section 3.1.5 of this specification.

3.1.4.2.5. CSCI005 Sensor Scaling and Offsetting Adjustments. The ERMS shall [1] provide for adjustment (correction) of raw sensor outputs through the use of software scales and offsets. The scale adjustment shall [2] be a multiplication factor

corresponding to the slope of the characteristic curve associated with a particular sensor. The offset shall [3] be a positive or negative adjustment corresponding to the Y-intercept of the characteristic curve associated with a particular sensor. A software Metric-units-to-English-units and English-units-to-Metric-units conversion function shall [4] be provided.

3.1.4.2.6. CSCI006 System Access Security. The cell controller shall [1] provide for storage of the following security-related data for access by a security access control software module through the MPS interface and the PMDT interface: user identification, passwords, four levels of access codes, and system sign-on and sign-off times. Multiple levels of local security access control shall [2] be provided. At each level, the lower levels shall [3] be transparent to higher level access and commands. The security of the system shall be such that there shall [4] be four levels of security each having a higher priority than its predecessor and each requiring different passwords regardless of user identification. The lowest level shall [5] allow access only to the display of monitored system values, parameters, settings and shall [6] be active at all times. This level shall [7] be equivalent to a "read only" operation, shall [8] only accept display commands, and shall [9] not accept or process any type of system command. The second level of security shall (10) be equivalent to "read and execute" and shall (11) allow the user the use of interactive system commands, control, and communication as well as the ability to display all system data and change SITEGEN data thresholds. The third user level of security shall (12) be equivalent to "read" "write", and "execute" and shall (13) consist of security level 1 and 2 access plus access authorization to modify the system's program logic and configure the system. The fourth level shall [14] consist of security levels 1 - 3 access plus access to permit change of the security system's ID and password assignments. All user levels shall [15] be assignable by a level 4 "super-user" or system administrator.

3.1.4.2.7. CSCI007 Software Programming Languages. A high level programming language or languages (maximum of three) to include extended relay ladder logic (ERLL) shall be used to create and execute the logical statements necessary for performing all ERMS functions not accommodated by the operating system(s). Programming languages for use on the PMDT will be IBM PC/AT compatible and will be furnished by the government.

3.1.4.3. ERMS Sensor and Controller Configuration Items (ESCIs). The following named sensors, switches, relay contacts, and sensor derived parameters are designated as configuration items in this specification. The designation ESCI followed by a three digit unique designator has been assigned to these items. The column headed by "MAX NO." contains the maximum number of each named item to be used in any single ERMS installation:

ESCI DESIGNATOR	MAX NO.	NAME
ESCI001	6	Commercial and Engine Generator Voltage Sensor (see 3.2.3.1).
ESCI002	3	Commercial and Engine Generator Current Sensor (see 3.2.3.2).
ESCI003	1	E/G Oil Level Sensor (see 3.2.3.3).
ESCI004	1	E/G Coolant Level Sensor (see 3.2.3.4).
ESCI005	1	E/G Radiator Airflow Sensor (see 3.2.3.5).
ESCI006	1	Ventilator Louver Position Sensor (see 3.2.3.6).
ESCI007	1	E/G Fuel Tank Level Sensor (see 3.2.3.7).
ESCI008	1	E/G Battery Terminal Voltage Sensor (see 3.2.3.8).
ESCI009	1	E/G Transfer Switch Position Sensor (see 3.2.3.9).
ESCI010	1	E/G Oil Pressure Sensor (see 3.2.3.10).
ESCI011	1	E/G Frequency Sensor (see 3.2.3.11).
ESCI012	1	E/G Coolant Temperature Sensor (see 3.2.3.12).
ESCI013	2	Room Temperature Sensor (see 3.2.3.13).
ESCI014	14	Supply and Return Air Temperature Sensor (see 3.2.3.14).
ESCI015	1	Outside Air Temperature Sensor (see 3.2.3.15).
ESCI016	9	Heating, Cooling, Ventilation, and HVAC Airflow Sensor(s) (see 3.2.3.16).
ESCI017	4	Fire and Smoke Detection Sensor(s) (see 3.2.3.17).
ESCI018	9	Intrusion Sensor(s) (see 3.2.3.18).
ESCI019	1	Remote E/G Start/Stop Relay(s) (see 3.2.4.1.1).
ESCI020	1	E/G Emergency Stop (Mechanical Switch) (see 3.2.3.8).
ESCI021	1	E/G Start (centrifugal or Murphy Switch).
ESCI022	1	E/G On (OLX Contact)
ESCI023	4	E/G Lockouts (4 – Automatic Switches) (see 3.2.3.19).
		a. E/G Overspeed
		b. E/G Overcrank

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ESCI005	1	E/G Radiator Airflow Sensor (see 3.2.3.5).
ESCI006	1	Ventilator Louver Position Sensor (see 3.2.3.6).
ESCI007	1	E/G Fuel Tank Level Sensor (see 3.2.3.7).
ESCI008	1	E/G Battery Terminal Voltage Sensor (see 3.2.3.8).
ESCI009	1	E/G Transfer Switch Position Sensor (see 3.2.3.9).
ESCI010	1	E/G Oil Pressure Sensor (see 3.2.3.10).
ESCI011	1	E/G Frequency Sensor (see 3.2.3.11).
ESCI012	1	E/G Coolant Temperature Sensor (see 3.2.3.12).
ESCI013	2	Room Temperature Sensor (see 3.2.3.13).
ESCI014	14	Supply and Return Air Temperature Sensor (see 3.2.3.14).
ESCI015	1	Outside Air Temperature Sensor (see 3.2.3.15).
ESCI016	9	Heating, Cooling, Ventilation, and HVAC Airflow Sensor(s) (see 3.2.3.16).
ESCI017	4	Fire and Smoke Detection Sensor(s) (see 3.2.3.17).
ESCI018	9	Intrusion Sensor(s) (see 3.2.3.18).
ESCI019	1	Remote E/G Start/Stop Relay(s) (see 3.2.4.1.1).
ESCI020	1	E/G Emergency Stop (Mechanical Switch) (see 3.2.3.8).
ESCI021	1	E/G Start (centrifugal or Murphy Switch).
ESCI022	1	E/G On (OLX Contact)
ESCI023	4	E/G Lockouts (4 – Automatic Switches) (see 3.2.3.19).
		a. E/G Overspeed
		b. E/G Overcrank

properly formatted message output at the interface I/O port. The multi-processing functions also performed during each one-second scan, processing, and control cycle (200ms + 700ms) (±100ms) shall [4] include: I/O service, data I/O management, self-diagnostics, fault-isolation analysis, confidence count processing, alarm and alert detection and reporting delay processing, data storage in memory, and message formatting in Appendix IA and IB defined formats for transmission to the MPS and PMDT. All alarms, alerts, and messages transmitted for display shall [5] contain the date and time stamp of their occurrence. Alarm and alert values, having met confidence count and time delay parameters, shall [6] be set and stored in an alarm or alert buffer for transmission to the MPS and PMDT. For a list of typical threshold values, see Appendix IV. In addition, and simultaneously with the scan process, the cell controller shall [7] perform environmental equipment control functions when so requested by program or on-line commands within two (2) seconds of receipt of commands from the MPS or PMDT measured from receipt of the first character of the command sequence at the I/O port to the reception of the actuation signal at the actuating mechanism. Analytical and report data requests shall [8] be acknowledged within two (2) seconds, measured from time of receipt of the first character of input (request) data to the time of arrival of the first character of output response at the I/O interface. Actual compilation and reporting of the requested data shall [9] occur within two (2) minutes of receipt of request as measured from the time of receipt of the request at the I/O interface to the arrival of the first character of data output at the I/O interface port. Analytical and report data requirements are listed below and additionally in section 3.2.2.9.

3.1.5.1. Monitor Commercial Electrical Power System. Commercial voltage shall [1] be monitored for processing and display to the nearest volt; commercial current shall [2] be monitored for processing and display to the nearest ampere.

3.1.5.1.1. Monitor Phase Voltages. Phase voltage values shall [1] be measured line-to-neutral for processing and displayed as line-to-line or phase-to-phase to the nearest volt at the option of the user. Commercial voltages shall [2] always be monitored for processing and display whether the E/G is running or off. An example display for commercial voltages is as shown in Appendix II, screen presentation.

3.1.5.1.2. Monitor Phase Load Currents. Phase current values shall [1] be monitored for processing and display to the nearest ampere and shall [2] be used to indicate the total facility load current when the facility is powered by commercial power.

3.1.5.1.3. Monitor Facility Use of Power (KW). Information concerning the facility use of electrical power shall [1] be

derived from both commercial and E/G voltage and load current for maintenance and operational analysis using an assumed power factor (default = 0.8) to be input during SITEGEN. Values shall [2] be calculated and displayed in kilowatts regardless of the source of power.

3.1.5.2. Monitor Engine Generator Group.

3.1.5.2.1. Record Accumulated Hours of Operation. (Derived from ESCI021). The total amount of time the standby E/G has been run shall [1] be stored in computer memory as accumulated-hours. Input shall [2] be obtained by direct connection to the E/G ON discrete input. Each time the discrete input from E/G ON cycles from OFF to ON the value of E/G-run-time shall [3] be reset to zero and, thereafter, each minute of that the input remains on shall [4] be accumulated in computer memory as E/G-run-time. Each time the discrete input from E/G ON cycles from an ON to an OFF condition, the current value of E/G-run-time shall [5] be added to the accumulated-hours memory location.

3.1.5.2.2. Record Hours of Operation and Date and Time of Last Run. (Derived from ESCI021). Values identifying the run time and last date and time that the E/G was operated shall [1] be stored in computer memory. The stored E/G-run-time value shall [2] be incremented each minute that the E/G is running. Each time that the E/G ON discrete input transitions from OFF to ON, the counter shall [3] be reset to zero and the current day, month, year, hour, and minute stamp (E/G start) shall be stored in computer memory. An alert shall [4] be generated each four hours of continuous operation and shall [5] remain on until acknowledged.

3.1.5.2.3. Record Total Number of Automatic E/G Operations per Month and per Year. (Derived from ESCI021 and ESCI019). A value identifying the number of automatic E/G starts shall [1] be stored in computer memory and accumulated on a daily, monthly, and yearly basis. A computer memory location shall [2] contain a value representing the number of E/G operations during the preceding 30 days. This 30 day memory location value shall [3] be incremented each time the discrete E/G ON input transitions from OFF to ON without a remote E/G start signal. The E/G 30 day operations value shall [4] be calculated by adding all values in the preceding 29-day period to the value in the daily operations memory location as of 0000 hours each day. A computer memory location shall [5] maintain the annual value containing the sum of the preceding 12, 30 day periods. This memory location value shall [6] be updated each 30 days from the 30 day operations value

3.1.5.2.4. Monitor Engine Oil Level. The engine oil level shall [1] be monitored in both the engine OFF and engine ON condition. There shall [2] be two float switches activated by the oil levels

being monitored; an upper minimum oil level shall [3] be monitored when the engine is off and a lower minimum level shall [4] be monitored when the engine is running. After an engine run is completed and the engine has stopped, the upper level monitoring shall [5] be disabled for a period of two hours in order to allow the oil to drain back into the sump or pan. When the two hour timeout is complete, the upper level monitoring shall [6] again be activated until the next engine run cycle is commenced. An alarm shall [7] be generated when the oil level falls below the minimum level established by the switch position for the currently active switch as determined by the E/G on/off condition.

3.1.5.2.5. Monitor Engine Radiator Coolant Level. The radiator coolant level shall [1] be monitored when the E/G is off. After an engine run is completed and the engine has stopped, the coolant level sensor shall [2] be disabled for a period of two hours. When the two hour timeout is complete, coolant level monitoring shall [3] be activated until the next engine run cycle is commenced. A low-level dc voltage shall [4] be supplied through the ESCI to the I/O port on the cell controller. Any activation of the ESCI contacts shall [5] initiate an alarm.

3.1.5.2.6. Monitor Engine Fan Operation (Air Flow). Radiator air flow shall [1] be monitored any time the E/G is operating. A low-level dc voltage signal shall [2] be supplied to the cell controller through CLOSED contacts of the air flow switch (see Appendix III, Figure 4). Radiator air flow monitoring shall [3] be disabled when the ESCI018, intrusion ESCI, indicates an open door (or other opening). An OPEN condition shall [3] cause the cell controller to output an alarm message if the E/G centrifugal or Murphy switch indicates the E/G is ON.

3.1.5.2.7. Monitor Operation of Immersion Heater. (Derived from ESCI012). Operation of the immersion heater shall be derived from the value provided by the engine coolant temperature ESCI when the engine is not running (see 3.1.5.2.17 and 3.1.5.2.20).

3.1.5.2.8. Monitor Operation of Engine and Equipment Room Fans and Louvers. The E/G intake and E/G room ventilation (louver) ESCI(s) (see Appendix III, Figure 10) shall [1] provide an indication of the open or closed position of the ventilator louver(s) which control air flow in the engine room, and, shall [2] provide an alarm when the louver(s) fail to open when the E/G is running. Ventilator louver monitoring for the E/G shall [3] be disabled when the engine room intrusion ESCI indicates an open door or other opening. An alarm shall [4] be generated when the E/G is not running and one or more engine room louvers are open for more than 30 ±1 seconds. Monitoring of the equipment room ventilator louver(s) shall [5] have a 30-second delay before an alarm is generated.

being monitored; an upper minimum oil level shall [3] be monitored when the engine is off and a lower minimum level shall [4] be monitored when the engine is running. After an engine run is completed and the engine has stopped, the upper level monitoring shall [5] be disabled for a period of two hours in order to allow the oil to drain back into the sump or pan. When the two hour timeout is complete, the upper level monitoring shall [6] again be activated until the next engine run cycle is commenced. An alarm shall [7] be generated when the oil level falls below the minimum level established by the switch position for the currently active switch as determined by the E/G on/off condition.

3.1.5.2.5. Monitor Engine Radiator Coolant Level. The radiator coolant level shall [1] be monitored when the E/G is off. After an engine run is completed and the engine has stopped, the coolant level sensor shall [2] be disabled for a period of two hours. When the two hour timeout is complete, coolant level monitoring shall [3] be activated until the next engine run cycle is commenced. A low-level dc voltage shall [4] be supplied through the ESCI to the I/O port on the cell controller. Any activation of the ESCI contacts shall [5] initiate an alarm.

3.1.5.2.6. Monitor Engine Fan Operation (Air Flow). Radiator air flow shall [1] be monitored any time the E/G is operating. A low-level dc voltage signal shall [2] be supplied to the cell controller through CLOSED contacts of the air flow switch (see Appendix III, Figure 4). Radiator air flow monitoring shall [3] be disabled when the ESCI018, intrusion ESCI, indicates an open door (or other opening). An OPEN condition shall [3] cause the cell controller to output an alarm message if the E/G centrifugal or Murphy switch indicates the E/G is ON.

3.1.5.2.7. Monitor Operation of Immersion Heater. (Derived from ESCI012). Operation of the immersion heater shall be derived from the value provided by the engine coolant temperature ESCI when the engine is not running (see 3.1.5.2.17 and 3.1.5.2.20).

3.1.5.2.8. Monitor Operation of Engine and Equipment Room Fans and Louvers. The E/G intake and E/G room ventilation (louver) ESCI(s) (see Appendix III, Figure 10) shall [1] provide an indication of the open or closed position of the ventilator louver(s) which control air flow in the engine room, and, shall [2] provide an alarm when the louver(s) fail to open when the E/G is running. Ventilator louver monitoring for the E/G shall [3] be disabled when the engine room intrusion ESCI indicates an open door or other opening. An alarm shall [4] be generated when the E/G is not running and one or more engine room louvers are open for more than 30 ±1 seconds. Monitoring of the equipment room ventilator louver(s) shall [5] have a 30-second delay before an alarm is generated.

3.1.5.2.11. Monitor and Control Engine Cranking Time. (Derived from ESCI021 and ESCI022). Two memory locations shall [1] be defined in computer memory. The first shall [2] contain the value for current E/G cranking time. The second shall [3] contain the value for previous E/G cranking time. Both values shall [4] be stored in seconds. The elapsed E/G cranking time value for the most recent E/G start shall [5] be stored in memory in seconds as current E/G crank time. When the discrete input indicating that the E/G is cranking transitions from OFF to ON, this value shall [6] be reset to zero. While this input is active and the E/G is cranking, the value shall [7] be incremented once each second. When the E/G stops cranking, or the E/G centrifugal or Murphy switch closes, the current E/G crank time shall [8] be moved to a previous crank time memory location. Two automatic remote start E/G crank cycles without an E/G start shall [9] be permitted. Each cycle shall [10] consist of not more than 4, 15 second cranking periods with a 15 second non cranking period between each. If the E/G fails to start after completing two cranking cycles, an alarm shall [11] be generated and the remote automatic start control function shall [12] be inhibited until reset by an environmental technician using an PMDT.

3.1.5.2.12. Monitor Position of Power Transfer Switch. The transfer switch position shall [1] be monitored through the use of an auxiliary switch (ASCO 249-322 or equal) to be physically installed on the transfer switch housing. The power transfer switch position ESCI shall [2] provide the cell controller with information which denotes the current position of the transfer switch, i.e., E/G, or commercial power positions. If the power transfer switch remains in an intermediate position (i.e., in neither the E/G or Commercial positions) for more than 10 seconds, an alarm shall [3] be generated for display. The auxiliary switch contacts shall [4] be fed a 10 Vdc supply from the dc power supply, and in turn shall [5] provide this voltage as an input to the cell controller.

3.1.5.2.13. Monitor Engine Oil Pressure. An E/G oil pressure transducer shall [1] be connected in series with the existing analog gauge supplied with the E/G. The transducer shall [2] measure pressure in the range from 0 psig to 100 psig with output readable to 1 psig. In order to eliminate false alarms indicating low oil pressure when the engine is in the starting cycle, a 30 ±1 second delay in the monitoring of values, after the E/G centrifugal or Murphy switch closes, shall [3] be incorporated in the cell controller. When the engine is not in operation, a "*" shall [4] be generated for display.

3.1.5.2.14. Monitor E/G Phase Output Voltage. The E/G output phase voltage values shall [1] be measured line-to-neutral and shall [2] be monitored for processing and display as line-to-line or phase-to-phase to the nearest volt. E/G voltages shall [3] display a value only when the E/G running ESCI is ON. When the

E/G is in an OFF condition, a "*" shall [4] be generated for display. A sample display format for Commercial and E/G voltages is as shown in Appendix II.

3.1.5.2.15. Monitor E/G Output Frequency.
The E/G power output frequency shall [1]be monitored. A frequency-to-voltage converter integrated circuit (IC) and support circuitry shall [2] monitor one phase line of the 120 Vac E/G output. The cell controller shall [3] not report frequency values for 30 ±1 seconds after the E/G running ESCI has transitioned from OFF to ON. When the engine is not running, the value "*" shall [4] be generated for display. The frequency value to be transmitted for display shall [5] be to the nearest 0.1 Hertz.

3.1.5.2.16. Monitor E/G or Commercial Power Load Current. Load current ESCIs shall [1] be used to monitor the current in each phase of a three-phase system or in the line of a single phase system (see Appendix III, Figure 1). The information shall [2] be monitored for processing and display in units of amperes. Load current value (line and phase) shall [3] be transmited for display to the nearest ampere.

3.1.5.2.17. Monitor Engine Coolant Temperature. The temperature of the E/G coolant shall [1] be monitored in E/G ON and OFF conditions. When the E/G is ON, the temperature shall [2] be transmitted for display as E/G operating temperature. When the E/G is OFF, the temperature shall [3] be transmitted for display as E/G immersion heater operation. Separate threshold limits shall [4] be established for each to provide alarm conditions. The cell controller shall [5] provide an absolute alarm when the temperature goes below +80 or higher than +220 degrees F. An absolute alarm is defined as one which will occur regardless of the value set during SITEGEN. Coolant temperature shall [6] be transmitted for display in degrees Fahrenheit (°F) (see Section 3.2.3.1.2). The output of the ESCI shall [7] be a dc voltage proportional to the temperature.

3.1.5.2.18. Monitor Engine Shutdown Timer (Cool-down Cycle). (Derived from ESCI-011 and ESCI-009). Monitoring of the operation of the 4-minute shutdown timer shall [1] be provided when the E/G has entered the cool-down transition prior to shutdown. This function shall [2] not apply to no-load E/G test operation. When the power transfer switch transitions from E/G to Commercial power, the cell controller shall [3] initiate a software timer incrementing its value once each second until the engine ON ESCI (022) transitions from ON to OFF. If the value contained in the timer memory location is greater than 4 minutes, an alarm shall [4] be transmitted for display together with the timer value.

3.1.5.2.19. Monitor Engine Safety Lockout Switches Positions. The positions of the E/G safety lockout relays in the engine panel shall [1] be monitored. There are four pre-existing E/G safety lockout switches that function automatically if any of the monitored, parameters of E/G overtemperature, E/G oil pressure, E/G overcrank, and E/G overspeed are exceeded. This function shall [2] also monitor and report the position of the E/G Stop switch. The location of these circuits is shown in Appendix V. An alarm shall [3] be transmitted for display when any of these five circuits are activated (see 3.2.3.1.9).

3.1.5.2.20. Monitor Engine ON/OFF. The position of the built-in Auxillary Pilot (OLX) relay and the E/G centrifugal or Murphy switch (ESCI022) relays shall [1] be monitored. These relays shall [2] provide a discrete (on/off) ESCI voltage as an input to the cell controller. When the engine is not running, the OLX RELAY is open. When the start sequence is initiated, it closes and remains closed until the engine ignition is turned off. The E/G centrifugal or Murphy switch contacts close when the E/G RPM increases above 400 RPM and open when E/G RPM decreases below 400 RPM.

a. When the E/G centrifugal or Murphy switch closes (E/G running transitions from OFF to ON) the following events shall [3] occur within one second of switch closure:

   1. An E/G ON change-of-state message shall [4] be stored in computer memory for transmission to the MPS and PMDT.

   2. E/G oil upper-level monitoring shall [5] be disabled .

   3. A 30 ± 1 second software timer shall [6] be started, and, after its expiration, ESCIs for the E/G intake air vent, radiator airflow, low oil pressure safety, oil pressure, ac frequency and ac power line voltages shall [7] be enabled for monitoring.

   4. The number of E/G operations value in computer memory shall [8] be incremented by one.

   5. E/G run time value in computer memory shall [9] be incremented for each minute that the E/G running ESCI is ON.

b. When the E/G centrifugal or Murphy switch opens (E/G running transitions from ON to OFF) the following events shall [10] occur within one second of switch opening:

1. An E/G OFF change-of-state message shall [11] be stored in computer memory for subsequent transmission to the MPS and PMDT.

2. A two-hour software timer shall [12] be started and, after it has expired, upper E/G oil level monitoring shall [13] start, E/G OFF coolant temperature monitoring for immersion heater operation shall [14] begin, and E/G OFF coolant level monitoring shall [15] begin.

3. Monitoring for E/G radiator airflow, low oil pressure safety, oil pressure, ac frequency, and E/G line output voltages shall [16] be terminated.

4. E/G runtime shall [17] be added to the cumulative E/G runtime value and the current E/G runtime value shall [18] be set to zero.

3.1.5.3. Monitor ERMS and Facility Emergency Backup Battery Systems. The ERMS shall monitor battery float, equalizing, and output voltages for the ERMS UPS, and the E/G Group batteries or facility backup batteries as dictated by the facility configuration.

3.1.5.3.1. Monitor Battery Systems Float (Input) Voltage (all Batteries). The voltages of facility backup, E/G group, and ERMS uninterruptable power supply batteries during normal no-load "trickle" charging state (float state) shall [1] be transmitted for display. The normal and alarm and alert voltage ranges are unique to the battery type and configuration at each facility, therefore, they shall [2] be individually established in the cell controller monitoring software during ERMS SITEGEN (see Appendix II).

3.1.5.3.2. Monitor Battery Systems Equalizing (Input) Voltage (all Batteries). (Derived from ESCI008 and ESCI024). The voltage of E/G group, and facility and ERMS backup batteries during periodic battery voltage equalizing periods shall [1] be transmitted for display. During these periods the battery float voltage range (X volts to Y volts) will be increased by an amount (+Z volts) and a new range (X+Z to Y+Z) volts shall [2] be monitored for a period of T minutes. These voltages (X, Y, & Z) and their corresponding alarm values as well as the time period "T" are unique to the battery type and configuration at each facility and thus their alarm and alert values shall [3] be individually established in the cell controller monitoring software during ERMS facility SITEGEN (see Appendix II).

3.1.5.3.3. Monitor Battery Systems Output Voltage (all Batteries). (Derived from ESCI008 and ESCI024). The output voltage of E/G group, and facility and ERMS backup batteries shall [1] be transmitted for display. The normal and alarm battery output voltage ranges are unique to the battery type and configuration at each facility, therefore, they shall [2] be individually established in the cell controller monitoring software during ERMS facility SITEGEN.

3.1.5.4. Monitor Building Parameters

3.1.5.4.1. Monitor Room Temperatures. The normal operation of the heating, cooling and ventilation equipment shall [1] be monitored using room temperature ESCI(s). E/G and equipment room temperatures shall be separately monitored for processing and display. The room temperature ESCI(s) shall [2] output a dc voltage proportional to the measured temperature.
The equipment room temperature shall [3] have variable alarm and alert points, depending on which environmental conditioning system (i.e., heating, cooling) is in operation. E/G battery room temperature alarm points shall [4] be separately set. All room temperatures shall [5] be transmitted for display in degrees Fahrenheit.

3.1.5.4.2. Monitor Supply and Return Air Temperatures.
Facilities may have one or more types of environmental conditioning systems installed (i.e., an HVAC system, separate heating and cooling systems, etc.). Each shall be transmitted for display by supply and return air temperature ESCIs installed in each equipment's air supply and return duct.

3.1.5.4.3. Monitor Outside Air Temperature. The outside air temperature (OAT) shall [1] be transmitted for display in degrees Fahrenheit (°F) using a temperature sensor device similar to that shown in Appendix III, Figure 9. A 24 Vdc sense voltage shall [2] be applied to a thermistor in series with a current-limiting resistor (nominal 5.5 kOhm). This device shall [3] be a thin film linear platinum RTD. The thermistor voltage drop shall [4] be connected to a cell controller analog input channel. The ESCI shall [5] be mounted in a shaded area in a plastic weatherproof enclosure. The ESCI shall [6] be a two-wire device requiring a 24 Vdc input. The current value shall [7] be monitored and displayed after processing by a linear conversion function.

3.1.5.4.4. Monitor Air Flow for Each Forced Air Unit. The operation of each environmental conditioning system, where airflow is a necessary function for system operation, shall [1] be transmitted for display. Air movement shall [2] be detected by the use of a properly-positioned micro-switch and vane or other suitable air motion detection arrangement. ESCIs shall [3] be

3.1.5.3.3. Monitor Battery Systems Output Voltage (all Batteries). (Derived from ESCI008 and ESCI024). The output voltage of E/G group, and facility and ERMS backup batteries shall [1] be transmitted for display. The normal and alarm battery output voltage ranges are unique to the battery type and configuration at each facility, therefore, they shall [2] be individually established in the cell controller monitoring software during ERMS facility SITEGEN.

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The equipment room temperature shall [3] have variable alarm and alert points, depending on which environmental conditioning system (i.e., heating, cooling) is in operation. E/G battery room temperature alarm points shall [4] be separately set. All room temperatures shall [5] be transmitted for display in degrees Fahrenheit.

3.1.5.4.2. Monitor Supply and Return Air Temperatures.
Facilities may have one or more types of environmental conditioning systems installed (i.e., an HVAC system, separate heating and cooling systems, etc.). Each shall be transmitted for display by supply and return air temperature ESCIs installed in each equipment's air supply and return duct.

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3.1.5.4.4. Monitor Air Flow for Each Forced Air Unit. The operation of each environmental conditioning system, where airflow is a necessary function for system operation, shall [1] be transmitted for display. Air movement shall [2] be detected by the use of a properly-positioned micro-switch and vane or other suitable air motion detection arrangement. ESCIs shall [3] be

to start. The unit stop signal shall [5] be applied for 5 seconds. When the unit stop signal is initiated the cell controller shall [6] process an MPS and PMDT display for initiation of the stop sequence, E.G., "STOP SEQUENCE INITIATED". After the unit has stopped, the cell controller shall [7] process the following messages for display:

1. Engine Generator OFF
2. Heater, Ventilator, A/C or HVAC) OFF .

Other cell controller messages that shall [8] be generated for display when required are:

1. Automatic Thermostat (DISABLED or ENABLED)
2. ERMS control of Temperature (DISABLED or ENABLED)
3. MPS and PMDT manual temperature control (DISABLED or ENABLED)

3.1.5.6.1. Provide Remote Engine START and STOP Control. Control shall be provided for remotely starting and stopping the E/G through the use of a 24 Vdc start and a 24 Vdc stop relay as follows (see 3.2.4.1):

a. Remote Start - Upon receipt of a remote start command from the MPS and PMDT, the cell controller shall [1] energize the OLX relay (see Appendix V) and shall [2] initiate an automatic E/G start cycle that shall [3] be controlled by the cell controller. The automatic start cycle shall [4] consist of 4, 15-second cranking periods each with a 15 non cranking period between each. Two automatic starting cycles shall [5] be permitted without E/G start occurring. At the completion of the second starting cycle without E/G start, further remote start attempts shall [6] be inhibited until the cell controller is reset by an onsite environmental technician using a PMDT.

b. Remote Stop - Upon receipt of a remote stop command from the MPS and PMDT, the cell controller shall [7] de-energize the OLX relay.

3.1.5.6.2. Heating, Ventilation, Cooling and HVAC System Control (ON/OFF). Three modes of operation for remotely starting, stopping, and controlling the individual heating, ventilation, cooling, and HVAC systems [1] shall be provided:

a. Normal System Operation
b. ERMS System Control Operation
c. MPS and PMDT (remote manual) System Control Operation

Under normal system operation, the local facility thermostat(s) control the operation of the environmental conditioning system(s). In the ERMS system (b) control mode, the local thermostat(s) that normally control the operation of these systems shall [2] be electrically isolated from the associated equipment and a desired temperature set point shall [3] be entered through the MPS and PMDT. In this mode, the cell controller shall [4] control the room temperature within a preset range of ± 2° F using input(s) from the room air temperature ESCI. In the remote manual (c) mode, the local facility thermostat(s) shall [5] be disabled and the MPS and PMDT operator shall [6] manually command the appropriate equipment ON and OFF.

3.1.5.7. Input/Output Display Support.

a. The cell controller microprocessor shall perform the following functions:

1. User Interface Function. This function shall [1] require a menu driven, full screen display at the PMDT level that shall [2] allow the selection and execution of all data processing, monitoring, controlling, and system administration and analysis functions (see Appendix II). The same data (but not necessarily in the same communications protocol data format) provided to the PMDT via Interface 2 shall [3] be provided to the MPS via Interface 1 (see Appendices IA and IB).

b. The PMDT shall [1] perform and the cell controller shall [2] provide data for the following functions:

1. Print Function (Screen): This function shall [1] allow the operator to print a logical group report. A logical grouping shall [2] be defined as: a.) A Facility Group showing status of: room and OAT temperatures, fire and smoke ESCIs, intrusion ESCIs, louver ESCIs, obstruction light ESCI; b.) Engine Generator Group showing all E/G related data points except timers; c.) HVAC Group showing all heating, air conditioning, and ventilation related data points; d.) E/G Timers Group showing E/G crank times and E/G current and cumulative times; e.) Terminal Group showing communication related data points; f.) Master Group showing all ERMS Group data points. This function shall [3] support the generation of reports defined in paragraph 3.2.2.9.

2. Alarm Print Function (Screen): Selection of this function shall cause the output in print format of a report of all ERMS data points that are currently in an alarm state.

3. Digital Data Point Print Function: Selection of this function shall permit the output in print format of a status report for all data points containing values from digital and discrete ESCIs .

4. Analog Data Point Print Function: Selection of this function shall permit the output in print format of a status report for all analog data points containing values from analog ESCIs.

5. Message Function (Screen): Selection of this function shall permit the posting of MPS and PMDT entered messages of up to 80 characters in length for transmission to the PMDT and MPS.

6. Message Storage Function (Screen): Selection of this function shall permit the entry and storage of a message of up to 450 characters in length which may be called up for display on the MPS and PMDT CRTs.

7. Date and Time Set and SITEGEN Function (Screen): Selection of this function shall permit the operator to set the current System time and date and to input facility unique variable parameters.

8. View Setpoints Function (Screen): Selection of this function shall permit the operator to inspect the high, low, and time delay (see screen SP/2, Appendix II) thresholds for each applicable data point.

9. Chancre Setpoints Function (Screen): Selection of this function shall permit the user to change the thresholds and time delays of applicable data points.

10. Mode Change Function: Selection of this function shall allow the PMDT user to toggle between local (PMDT) and remote (MPS) modes of operation.

11. Change-of-State Display Function: Selection of this function shall permit the dumping of the Alarm, Return to Normal, and Change of State message buffers to the PMDT and MPS consoles.

12. Analog Adjustment Function: Selection of this function shall permit the adjustment of all analog outputs by varying the respective offset and scale.

3. Digital Data Point Print Function: Selection of this function shall permit the output in print format of a status report for all data points containing values from digital and discrete ESCIs .

4. Analog Data Point Print Function: Selection of this function shall permit the output in print format of a status report for all analog data points containing values from analog ESCIs.

5. Message Function (Screen): Selection of this function shall permit the posting of MPS and PMDT entered messages of up to 80 characters in length for transmission to the PMDT and MPS.

6. Message Storage Function (Screen): Selection of this function shall permit the entry and storage of a message of up to 450 characters in length which may be called up for display on the MPS and PMDT CRTs.

7. Date and Time Set and SITEGEN Function (Screen): Selection of this function shall permit the operator to set the current System time and date and to input facility unique variable parameters.

8. View Setpoints Function (Screen): Selection of this function shall permit the operator to inspect the high, low, and time delay (see screen SP/2, Appendix II) thresholds for each applicable data point.

9. Chancre Setpoints Function (Screen): Selection of this function shall permit the user to change the thresholds and time delays of applicable data points.

10. Mode Change Function: Selection of this function shall allow the PMDT user to toggle between local (PMDT) and remote (MPS) modes of operation.

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12. Analog Adjustment Function: Selection of this function shall permit the adjustment of all analog outputs by varying the respective offset and scale.

EIIN	Interface Name	INTERFACE TYPE
001	ERMS-TO-MPSH	HARDWARE RS-232 DTE (MODEM)
002	ERMS-TO-PMDTH	HARDWARE RS-232 DCE (HARD WIRED)
003	ERMS-TO-MPSS	SOFTWARE (see Appendix I)
004	ERMS-TO-PMDTS	SOFTWARE (TBD* + GFS Tandem 6530 emulation software) (see Appendix IB)

* Interface protocol to be provided by the Government.

3.1.6.1.3. Hardware-to-Hardware External Interfaces.

a. EIIN001 - This interface (see Interface 1, Figure 2) shall [1] meet all interface requirements of EIA Standard RS-232 with regard to physical connection and the interchange of data, timing, and control signals for synchronous transmissions at 2400 bits-per-second, electrical signal characteristics, and mechanical connections. Interface connectors for systems communication ports on the ERMS shall [2] be 25-pin, D-type, female-configured as Data Terminal Equipment (DTE). If equipment separation is such that modems are not needed, the Government will provide a "null" modem including circuit interchange and timing source.

b. EIIN002 - This interface (see Interface 2, Figure 2) shall [1] meet all interface requirements of EIA Standard RS-232 with regard to physical connection and to the interchange of data, timing, and control signals for both synchronous and asynchronous transmissions, electrical signal characteristics, and mechanical connections. Interface connectors for systems communication ports on the ERMS shall [2] be 25-pin, D-type, female-configured as Data Communications Equipment (DCE).

3.1.6.1.4. Hardware-to-Software External Interfaces. No hardware-to-software external interfaces are defined for ERMS.

3.1.6.1.5. Software-to-Software External Interfaces.

a. EIIN003 - This shall [1] be a software-to-software MPS interface that shall perform in accordance

with the requirements of Appendix IB (See Section 3.1.4.b.5). All data exchanges between the ERMS and the MPS, RMSC, or RCE shall [2] be in the form of messages or frames that adhere to the protocols referenced in appendix IA. ERMS logical unit (LU) addresses shall be limited to the range from hexadecimal 80 through hexadecimal FE as required in FAA-E-2738. This interface shall [3] accommodate the MPS as the primary station that controls the sequence of data interchange and recovery operations within the data link and shall [4] include:

1. Initialization
2. Organization of the data flow
3. Re-transmission control
4. All recovery functions at the data link level

Each ERMS shall [5] 'be designated as a separately-addressed secondary station (except when connected to an RCE) and shall perform communication functions as directed by the primary station, including:

1. Accepting data (commands and messages) from the primary station.

2. Sending data, status, or other ERMS-related information to the primary station in response to data communications polling as referenced in appendix IA.

3. Returning positive and negative responses to the primary station in response to data communicatins polling as referenced in appendix IA.

b. EIIN004 shall [1] be a software-to-software interface that shall [2] meet the requirements of an interface protocol to be defined by the Government and Tandem 6530 PC emulation software to be furnished by the Government (see Appendix IB).

3.1.6.2. Internal Interfaces. Internal interfaces are those hardware and software interfaces required to achieve ERMS control, monitoring, and operational functions. They exist within the environment of the cell controller and its interfaces (I/O ports) (IOPs), CPUs, memory systems, and ESCI interface modules; and the associated ESCIs, relays, and switches, that are installed on or are within the facility and its equipment.

with the requirements of Appendix IB (See Section 3.1.4.b.5). All data exchanges between the ERMS and the MPS, RMSC, or RCE shall [2] be in the form of messages or frames that adhere to the protocols referenced in appendix IA. ERMS logical unit (LU) addresses shall be limited to the range from hexadecimal 80 through hexadecimal FE as required in FAA-E-2738. This interface shall [3] accommodate the MPS as the primary station that controls the sequence of data interchange and recovery operations within the data link and shall [4] include:

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1. Accepting data (commands and messages) from the primary station.

2. Sending data, status, or other ERMS-related information to the primary station in response to data communications polling as referenced in appendix IA.

3. Returning positive and negative responses to the primary station in response to data communicatins polling as referenced in appendix IA.

b. EIIN004 shall [1] be a software-to-software interface that shall [2] meet the requirements of an interface protocol to be defined by the Government and Tandem 6530 PC emulation software to be furnished by the Government (see Appendix IB).

3.1.6.2. Internal Interfaces. Internal interfaces are those hardware and software interfaces required to achieve ERMS control, monitoring, and operational functions. They exist within the environment of the cell controller and its interfaces (I/O ports) (IOPs), CPUs, memory systems, and ESCI interface modules; and the associated ESCIs, relays, and switches, that are installed on or are within the facility and its equipment.

3.1.6.2.2. HWCI-to-HWCI Interfaces. The following table lists the internal ERMS configuration item hardware-to-hardware interfaces based on HWCI Numbers:

TABLE II

HARDWARE INTERFACES

HWCI	FLOW	HWCI	TYPE
HWCI001	←	HWCI002	ac POWER
	N/A	HWCI003	dc POWER
	←	HWCI004	DISCRETE/ANALOG ESCI-LOCAL
	→	HWCI004	ac/dc CONTROL-LOCAL
	←	HWCI005	REMOTE E/G DISCRETE/ANALOG ESCI
	→	HWCI005	REMOTE E/G ac/dc/CONTROL
	↔	HWCI006	COMMAND/CONTROL/DATA
	↔	HWCI007	COMMAND/CONTROL/DATA

HWCI = Hardware Configuration Item
FLOW = Direction of electronic energy movement
TYPE = Characteristic(s) of the electronic energy

- The following information is provided for reference in identifying the HWCIs used in the table above:

HWCI	DESCRIPTION
001	CELL CONTROLLER
002	UPS
003	ESCI dc POWER SUPPLY
004	ESCIS, SWITCHES, CONTROL DEVICES (INTERFACE 3)
005	DISPLACED E/G UNIT (INTERFACE 4)
006	MPS COMMUNICATIONS INTERFACE (INTERFACE 1)
007	PMDT INTERFACE (INTERFACE 2)

3.1.6.2.3. HWCI-to-CSCI Interfaces. The following table defines the internal ERMS configuration item hardware-to-software interfaces based on HWCI and CSCI Numbers:

TABLE III

HARDWARE TO SOFTWARE

CSCI002	FIRMWARE	ROM/PROM/EPROM
CSCI003	FIRMWARE	ROM/PROM/EPROM
CSCI004	PROGRAMMABLE	NVRAM
CSCI005	PROGRAMMABLE	NVRAM
CSCI006	PROGRAMMABLE	NVRAM
CSCI007	PROGRAMMABLE	NVRAM
CSCI008	PROGRAMMABLE	RAM

LEGEND

HWCI:	Hardware configuration item
CSCI:	Computer software configuration item
NV:	Non-volatile (static or battery maintained)
RAM:	Random access memory
ROM:	Read only memory
PROM:	Programmable read only memory
EPROM:	Erasable programmable read only memory

The following information is provided for reference in identifying the CSCIs used in the table above:

CSCI	DESCRIPTION
001	OPERATING SYSTEM NUCLEUS
002	DATA I/O MANAGER
003	MULTI-TASKING MANAGER
004	MONITOR/CONTROL/COMM/ANALYSIS APPLICATIONS
005	ESCI INPUT OFFSET/LINEARITY ADJUSTMENT
006	ACCESS SECURITY
007	PROGRAMMING LANGUAGE(s)
008	PMDT DISPLAY APPLICATIONS

3.1.6.2.3. HWCI-to-CSCI Interfaces. The following table defines the internal ERMS configuration item hardware-to-software interfaces based on HWCI and CSCI Numbers:

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CSCI005	PROGRAMMABLE	NVRAM
CSCI006	PROGRAMMABLE	NVRAM
CSCI007	PROGRAMMABLE	NVRAM
CSCI008	PROGRAMMABLE	RAM

LEGEND

HWCI:	Hardware configuration item
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005	ESCI INPUT OFFSET/LINEARITY ADJUSTMENT
006	ACCESS SECURITY
007	PROGRAMMING LANGUAGE(s)
008	PMDT DISPLAY APPLICATIONS

TABLE IV
(contd.)
SOFTWARE-TO-SOFTWARE INTERFACES

CSCI	TYPE	FLOW	CSCI
CSCI005	INDIRECT		CSCI001
OFFSET/SCALE APPLICATIONS	OPERATION	↔	CSCI002
	OPERATION	↔	CSCI003
	INDIRECT		CSCI004
	OPERATION	↔	CSCI006
	OPERATION	↔	CSCI007
	CONTROL	→	CSCI008
CSCI006	OPERATION	↔	CSCI001
SECURITY APPLICATIONS	CONTROL	→	CSCI002
	CONTROL	→	CSCI003
	CONTROL	→	CSCI004
	CONTROL	→	CSCI005
	CONTROL	→	CSCI007
	CONTROL	→	CSCI008
CSCI007	INDIRECT		CSCI001
PROGRAMMING LANGUAGES	CONTROL	→	CSCI002
	OPERATION	↔	CSCI003
	CONTROL	→	CSCI004
	CONTROL	→	CSCI005
	OPERATION	↔	CSCI006
	INDIRECT		CSCI008
CSCI008	INDIRECT		CSCI001
PMDT DISPLAY APPLICATIONS	OPERATION	↔	CSCI002
	INDIRECT		CSCI003
	OPERATION	↔	CSCI004
	OPERATION	↔	CSCI005
	OPERATION	↔	CSCI006
	INDIRECT		CSCI007

Interface Type Definitions:

COMMAND:	Transmits data that may cause the execution of a CSCI
EXECUTION:	Transmits the response to a command
CONTROL:	Allows or disallows the execution of a CSCI
OPERATION:	Transmits the CSCI performance data for a specific function
INDIRECT:	No direct data interface exists

3.1.7. Government-Furnished Resources. The following resources are government furnished:

a. MPS and PMDT interface requirements documents

b. Tandem PC 6530 terminal emulation software

c. PMDT hardware and software

d. MPS interface simulator

e. NAILS Master Plan

f. Facility Drawings

g. Installation Location and Type Data

3.2. System Characteristics.

3.2.1. Hardware Characteristics. The ERMS hardware shall be defined as those items described and defined in HWCI001 through HWCI007 (see 3.1.4.1) plus enclosing cabinets or supporting rack(s), EMT tubing, flexible tubing, ESCI mounting hardware, twisted pair shielded ESCI connection wire, terminal blocks and associated mounting equipment.

3.2.1.1. Manufacture. The ERMS (cell controller and all components supporting the cell controller) shall [1] be standard commercial products which are currently offered for sale by more than one vendor and are currently in production. The cell controller and its components shall [2] be of the same model/series throughout all systems procured.

3.2.1.2. Component Construction. All components shall [1] be contained in metal cabinets or housings in accordance with NEMA Standard publication ICS 6-1983. All components shall [2] withstand the environmental conditions defined in Table IA and IB.

3.2.1.3. Modularity. The cell controller system shall [1] be modular in design with a plug-in CPU, I/O (interfaces) frames or assemblies, and shall [2] accept plug-in interface units for all hardware interfaces, i.e., (PMDT, ESCI modules, controllers, UPS, communications equipment, etc.).

3.2.1.4. Component Marking. All major assemblies, sub-assemblies, circuit cards, cables, and devices shall be permanently marked with the manufacturer's part identification, date code and serial number in accordance with and FAA-STD-012 and FAA-G-2100.

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3.2.1.4. Component Marking. All major assemblies, sub-assemblies, circuit cards, cables, and devices shall be permanently marked with the manufacturer's part identification, date code and serial number in accordance with and FAA-STD-012 and FAA-G-2100.

3.2.1.8.2. UPS Batteries. The UPS batteries shall [1] have an amp-hour rating sufficient to support the ERMS load for a minimum of two (2) hours with the inverter operating at full rated load. They shall [2] meet the requirements of FAA order 6980.24 for use in an electronic environment. The batteries shall [3] be contained within the UPS and shall [4] be protected from overcurrent conditions by a readily-accessible in-line fuse of the proper size. Batteries shall [5] have an operational life of 10 years. The UPS shall [6] contain an internal charge state maintenance and recharging system that will recharge discharged UPS batteries to 90% of full capacity in 2 X N hours (where N = the discharge time in hours) or less after restoration of line power.

3.2.1.8.3. UPS Inverter. The UPS inverter shall [1] be of pulse width modulation design with a sine wave output. Ferroresonant type units and units which produce a square wave or stepped wave output are not acceptable. The output voltage shall [2] be 120 Vac, +6% or -10% under full load. The output frequency shall [3] be 60 Hertz +/- 1%.

3.2.1.8.4. ESCI Power Supply. A low voltage dc power supply shall [1] be provided to support ESCI operation. The power supply shall [2] possess internal overvoltage protection, and shall [3] use compression-type screw terminals for 16-gauge minimum wire size.

3.2.1.8.5. Plugs and Connections: All electrical equipment using 120 Vac shall [1] be equipped with a minimum 6-foot, 3-wire power cord with plug. All other plugs and connections shall [2] be as defined for the appropriate hardware interface or configuration item in accordance with FAA-G-2100.

3.2.1.9. Cell Controller. The cell controller shall [1] not be constrained with regard to the number of CPUs, or the maximum amount or type of memory employed, to meet requirements. All HWCI devices shall [2] be connectable to, or disconnectable from, the cell controller while it is in operation without adversely affecting function *or* performance. The PMDT and Telecommunications I/O ports shall [3] interface to the cell controller by means of an electrical interface defined by EIA RS-232, specifically, a 25-pin, D-type, female connector, configured as DTE.

3.2.1.10 CPU(s) and Data Storage (Memory) The CPU(s) shall [1] process data contained in the program memory and data storage. Program memory shall [2] be available in a combination of non-volatile random access memory (NVRAM), and programmable read-only memory (PROM). Figure 3 provides information concerning memory types, relationships and uses.

a. The NVRAM shall [1] be of the complementary metal oxide semiconductor (CMOS) type, shall [2] have a battery backup system for the retention of all memory for a period of three (3) months, and shall [4] require no external or special vents for the battery. The battery shall [5] be replaceable without loss of memory integrity with the ac power off.

1. A visual indication of backup battery status shall [1] be provided. A local visual alarm shall [2] be provided before battery failure and subsequent memory loss.

2. Provision shall be made for connecting an external dc voltage to the system to provide auxiliary protection for CMOS NVRAM memories.

3. The program memory size shall [1] be a minimum of 32K bytes (16-bit words) and shall [2] be expandible in minimum increments of 2K bytes. Program memory shall [3] be expandable in the field by card or chip exchange. Available memory shall [4] exceed required memory at least 100% in the fully-functioning, maximally configured ERMS where maximum ERMS configuration is defined as one in which all HWCIs, ESCIs, and CSCIs are installed and operating in the maximum numbers specified herein.

b. A key-locking arrangement shall prevent memory modification.

3.2.1.11. I/O Devices (Interfaces 3 and 4). The cell controller's Interface 3 and 4 I/O structure shall [1] support multiple types (i.e., analog, discrete, ac, dc) and quantities of I/O modules. The ERMS shall [2] employ specific interface voltage level standards for discrete and analog voltages. The discrete dc voltage levels shall [3] be based on a 24 Vdc power rail used to interface to the low voltage dc power systems. To minimize electromagnetic interference and radio frequency interference (EMI and RFI) effects, ac voltages higher than 48 Vac shall [4] not be presented to the cell controller interface; analog input voltages to the cell controller shall [5] be scaled between 0 Vdc and 10 Vdc..

a. The cell controller shall [1] accommodate a minimum of 64 discrete inputs and 32 discrete outputs. I/O interface modules accommodating more than one discrete I/O shall [2] perform their

intended functions, when installed and interfaced to the cell controller, as a single module, multiples of the same module, or as mixes of different modules.

b. All cell controller inputs and outputs shall be operable as discrete (on/off) inputs or outputs.

1. The following types of discrete inputs and outputs shall [1] be available. They shall [2] have a minimum of one (1) channel and not more than twelve (12) channels on any single I/O module:

INPUTS	OUTPUTS
12 Vac/dc	12 Vdc
24 Vac/dc	24 Vdc
48 Vac/dc	48 Vdc

2. Discrete inputs shall [1] be guaranteed ON if 78% or more of nominal voltage is present, and shall [2] be guaranteed OFF if 20% or less of the nominal voltage is present.

3. Minimum isolation between I/O and logic voltages shall be 1,500 V RMS or greater. Optical circuit isolation techniques are preferred for use to achieve this requirement.

4. The ac discrete outputs shall [1] be rated at 20 amperes inrush, 2 amperes continuous, and 12 amperes maximum for 33 milliseconds (ms). dc discrete outputs shall [2] have a 2-ampere continuous rating. All outputs shall [3] have 3-ampere normal fuse protection.

5. Each discrete input and output shall have an LED or other visible indication of on/off status.

c. The system shall provide control functions via a single-pole double-throw (SPDT) relay output module.

1. The SPDT relay output module shall have a minimum of one (1) channel and not more than twelve (12) on any single output module.

2. Each relay shall be a form C type relay with the normally open (N.O.) or normally closed (N.C.) contacts jumper-selectable.

intended functions, when installed and interfaced to the cell controller, as a single module, multiples of the same module, or as mixes of different modules.

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2. Each relay shall be a form C type relay with the normally open (N.O.) or normally closed (N.C.) contacts jumper-selectable.

1. Shall employ the same hardware components as the local (interface 3) I/O arrangement except for any unique (internal interface) data communication requirements.

2. Shall [1] not require more than a single cable run of: shielded, six twisted pair, not larger than #22 AWG; stranded wire or coaxial cable; or fiber optic cable. If provided by fiber optic medium, the appropriate optical transmission and transducer interfaces shall [2] be supplied.

3. Shall provide remote communication I/O speeds sufficient to insure compliance with the requirements of paragraph 3.1.5.

4. Shall provide any number of remote discrete and analog I/O points (up to the CPU system capacity).

5. Shall [1] provide diagnostic lights. Lights shall [2] be available to indicate module power, continuity, and parity status. Self test diagnostic messages shall [3] be available to transmit to a higher-level processor or to a local terminal.

6. Physical dimensions of this unit shall be in accordance with paragraph 3.2.1.6.

3.2.2. Cell Controller Operating Characteristics. The ERMS cell controller shall possess the following characteristics:

3.2.2.1. Microprocessor Operatins System Characteristics. The operating system shall [1] be configurable by the PMDT and MPS to support from the minimum to the full range of ERMS operational functions and Interface 3 and 4 ESCI I/O points. The operating system shall [2] be a product currently offered for sale in the commercial environment with at least 50 systems in current operation.

a. Provisions shall [1] be made for the operating system to check all logic words for parity when read from memory; this is in addition to normal CPU fault control processing. A parity error shall [2] cause a system restart. If a second successive parity error occurs, an immediate shutdown of the ERMS shall [3] occur with both an alarm to the MPS and an on-equipment visual indication. An attempt shall [4] be made to transmit the alarm to the MPS and PMDT before ERMS shutdown.

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shall [2] include, as a minimum arithmetic operators of: addition, subtraction, multiplication, division, exponentiation, logarithms, and conditional operators. Conditional operators shall [3] include, as a minimum, equality, inequality, greater than, less than, greater than or equal to, and less than or equal to. These features shall [4] be available in signed, double-precision, integer, and scientific notation.

2. The operating system shall [1] be able to process data in lists or in tables. These lists shall [2] be at least 16 bits wide and 255 records long. Data processing shall [3] include a conditional mathematical sort function having a worst case sort capacity of 200 X 16 bit word items in not more than 200 ms. The cell controller shall [4] also generate FIFO and LIFO stacks. The cell controller shall [5] be able to pass the results of sorts to other files and registers.

3. The operating system, shall [1] use the Boolean logical operations of AND, OR, EXCLUSIVE OR, INCLUSIVE OR, NOT, and COMPARE. It shall [2] have matrix logic sufficient to process matrices of up to 16 bits X 255 records. Matrix logic functions shall [3] include all Boolean operations described above.

4. The numerical data for a math function, data list, or matrix, shall be able to be input from ERLL timers, counters, keyboard entries, higher level processors, and other math functions, data lists, or matrices.

5. The operating system shall [1] be able to use the results from math functions, data handling functions, and matrix functions for presets to ERLL timers and counters, and for operating system outputs. Results from these functions shall [2] also be accessable for processing and display on MPS and PMDT CRTs.

3.2.2.1.1. Self Diagnostics

a. The operating system shall [1] perform a self-diagnostic process each scan cycle. Any errors detected shall [2] be reflected as an error message stored in memory for subsequent transfer to the MPS and PMDT. The cell controller shall [3] allow the selection of one of three modes of operation after a failure: immediate ERMS shutdown, ERMS reset, and ERMS continued operation.

b. The self-test diagnostic function of the operating system shall [1] include, as a minimum: memory checksum testing, and the "watchdog" monitoring of the total process time required for one complete system scan, which shall [2] not exceed 200 ms (±50ms) including: program logic, HWCI service, and self-test times. The total system process time from receipt the first character of a command input at an interface to the arrival of the first character of output data at the same interface, including the system scan, shall [3] not exceed 1 second (± 50ms). A Watchdog Timer shall [4] signal the type of system error causing excess processing time and shall [5] enunciate a timing error to the MPS and PMDT. All timing errors shall [6] be reported as system errors to the MPS and PMDT to be transmitted for display during any operator intervention; a system status and fault isolation selection shall [7] be available from the main menu which shall display the status of all system tests.

3.2.2.2. Program Memory Characteristics. The CPU(s) shall be supported by the program memory and data storage (See Figure 3).

a. The entire program memory (32K bytes) shall [1] be available for user high level language program storage. Operating system resident or internal housekeeping and utility programs shall [2] not be contained in this memory area.

b. A minimum of 512 internal storage memory locations and registers shall [1] be available for data storage. These registers shall [2] be independent of, and in addition to, program storage memory. Total data storage capacity shall [3] be not less than 32K bytes. Any internal memory location shall [4] be able to assume a relay, latch relay, one-shot, timer, or counter function.

c. A minimum of 32K bytes of user utility memory (see figure 3) shall be available.

3.2.2.3. Data I/O Management Characteristics. The cell controller shall perform the following Data I/O Management functions without degrading or interrupting the monitor and control functions being performed.

a. The cell controller system shall [1] have a function for storing, and for formatting for

b. The self-test diagnostic function of the operating system shall [1] include, as a minimum: memory checksum testing, and the "watchdog" monitoring of the total process time required for one complete system scan, which shall [2] not exceed 200 ms (±50ms) including: program logic, HWCI service, and self-test times. The total system process time from receipt the first character of a command input at an interface to the arrival of the first character of output data at the same interface, including the system scan, shall [3] not exceed 1 second (± 50ms). A Watchdog Timer shall [4] signal the type of system error causing excess processing time and shall [5] enunciate a timing error to the MPS and PMDT. All timing errors shall [6] be reported as system errors to the MPS and PMDT to be transmitted for display during any operator intervention; a system status and fault isolation selection shall [7] be available from the main menu which shall display the status of all system tests.

3.2.2.2. Program Memory Characteristics. The CPU(s) shall be supported by the program memory and data storage (See Figure 3).

a. The entire program memory (32K bytes) shall [1] be available for user high level language program storage. Operating system resident or internal housekeeping and utility programs shall [2] not be contained in this memory area.

b. A minimum of 512 internal storage memory locations and registers shall [1] be available for data storage. These registers shall [2] be independent of, and in addition to, program storage memory. Total data storage capacity shall [3] be not less than 32K bytes. Any internal memory location shall [4] be able to assume a relay, latch relay, one-shot, timer, or counter function.

c. A minimum of 32K bytes of user utility memory (see figure 3) shall be available.

3.2.2.3. Data I/O Management Characteristics. The cell controller shall perform the following Data I/O Management functions without degrading or interrupting the monitor and control functions being performed.

a. The cell controller system shall [1] have a function for storing, and for formatting for

installation terminal. No additional terminals shall [3] be required to configure, program, or reprogram the cell controller to perform its intended function(s).

c. Software to support two serial I/O interfaces shall be provided.

1. Interface 1 shall [1] have a 4K sequential character buffer available and have software programmable baud rates from 1200 to 19.2K, in sequential steps (2400, 4800, and 9,600). Interface 1 shall [2] be defined as the remote MPS communication port and shall [3] support the communication protocol defined in Appendix IA.

2. Interface 1 shall [1] support communication using RS-232 compatible devices. In addition, Interface 1 shall [2] support implementation of the following protocols: ADCCP, SYNC, HDLC, and SDLC framing modes with error checking.

3. Interface 2 shall [1] be the PMDT monitoring and control interface. This interface shall [2] be capable of communication using RS-232 devices (see Appendix IB).

4. Interface 2 shall [1] have a 4K sequential character buffer and shall [2] have software or switch programmable baud rates from 1200 to 19.2K, in sequential steps (2400, 4800, and 9600).

5. Interface 2 shall support the protocol and PMDT requirements as specified in Appendix IB.

d. The ERMS shall continue to perform its intended function in the absence of higher level polling or communication.

e. The cell controller shall [1] sense the carrier detect (CD defined in EIA RS-232) for loss of carrier. Loss of carrier shall [2] result in the cell controller automatically accepting entry from the local PMDT port. Security access shall [3] be controlled locally.

f. The cell controller shall [1] sense the loss of polling. Loss of polling shall [2] result in the cell controller automatically accepting entry from the local PMDT port.

3.2.2.5 Application Software Characteristics. The seven ERMS applications of remote monitoring, status and alarm reporting, remote control, fault isolation, on-line data recording and data management, data analyses, and specialist access and security shall [1] be developed and implemented using the PMDT to achieve optimum man-machine interface compatibility. The ERMS cell controller shall [2] be programmable in a "high level" language (to include ERLL language), provide the functions of arithmetic operations, function calls, subroutine calls, and shall [3] process loop definitions. The high level language and application layer programs shall [4] be transportable between systems of common manufacture, as well as between differing manufacturers, using the same operating system.

a. The cell controller shall provide ERMS data for use by MPS and PMDT data presentation applications. PMDT data presentation applications shall be developed to provide full screen data displays as shown in appendix II, Screen Presentation of Parameters.

b. The memory resident cell controller application software shall provide remote monitoring, status and alarm and alert reporting, remote control, fault isolation, on-line data recording, data management, and specialist access and security for use by MPS and PMDT formatted screen displays.

c. The PMDT control and graphic presentations shall conform to the following specifications:

1. Color presentations shall [1] use red to enunciate alarms. This shall [2] include features to highlight the alarm by red background video, or red characters (shall [3] be flashing), or any combination thereof.

2. Color presentations shall [1] use yellow to enunciate alerts. This shall [2] include features to highlight the alert by yellow background video, or yellow characters.

3. Color presentations shall use green to enunciate normal or return-to-normal conditions.

4. Monochromatic display presentations shall use highlighted flashing video when displaying the alarm, and alert conditions; and highlighted only when displaying return-to-normal conditions.

5. Graphical PMDT presentations of parametric data such as analog meters, shall [1] be

represented by the following display modes and rates: increase values upward on the vertical axis, and clockwise on a rotational axis; increase values to the right on a horizontal axis. Discrete parameters shall [2] be presented as ON when up using the vertical axis, and right when using the horizontal axis. All analog presentations shall [3] be scaled appropriately to the intended function and may employ absolute data windows for clarity and accuracy.

d. The user shall not be required to convert any ERMS data presented on the MPS and PMDT displays.

1. All data for display shall [1] be scaled by the cell controller prior to output to the PMDT and MPS. Values displayed shall [2] not require additional references to determine their meaning.

2. Data shall not be presented to the user at rates greater than 5 value changes per second.

3.2.2.6 ESCI I/O Processing Characteristics. Offset scale and adjustment tables, alarm confidence count tables, alarm delay tables, and alarm and alert threshold tables shall be provided.

a. The cell controller shall [1] provide for adjustment of raw ESCI input through the use of software scales and offsets. The scale adjustment shall [2] be a multiplication factor corresponding to the slope of the characteristic curve associated with a particular ESCI. The offset shall [3] be a positive or negative adjustment corresponding to the Y-intercept of the characteristic curve associated with a particular ESCI. This process shall [4] permit the minimizing of accuracy errors introduced by nonlinearity or drift of ESCI output values.

b. An alarm confidence count table comparison value (local or remote user-keyboard-configurable value) shall [1] be defined for each ESCI. The confidence count table comparison value to be maintained in cell controller memory shall [2] be in scan-cycle units. The confidence count event value counter shall [3] be incremented by one during each successive scan cycle that the ESCI value is outside alarm and alert threshold value limits. The confidence count event value counter shall [4] be restarted from zero anytime that the ESCI measured value returns to within normal limits. When the value in the confidence count

represented by the following display modes and rates: increase values upward on the vertical axis, and clockwise on a rotational axis; increase values to the right on a horizontal axis. Discrete parameters shall [2] be presented as ON when up using the vertical axis, and right when using the horizontal axis. All analog presentations shall [3] be scaled appropriately to the intended function and may employ absolute data windows for clarity and accuracy.

d. The user shall not be required to convert any ERMS data presented on the MPS and PMDT displays.

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a. The cell controller shall [1] provide for adjustment of raw ESCI input through the use of software scales and offsets. The scale adjustment shall [2] be a multiplication factor corresponding to the slope of the characteristic curve associated with a particular ESCI. The offset shall [3] be a positive or negative adjustment corresponding to the Y-intercept of the characteristic curve associated with a particular ESCI. This process shall [4] permit the minimizing of accuracy errors introduced by nonlinearity or drift of ESCI output values.

b. An alarm confidence count table comparison value (local or remote user-keyboard-configurable value) shall [1] be defined for each ESCI. The confidence count table comparison value to be maintained in cell controller memory shall [2] be in scan-cycle units. The confidence count event value counter shall [3] be incremented by one during each successive scan cycle that the ESCI value is outside alarm and alert threshold value limits. The confidence count event value counter shall [4] be restarted from zero anytime that the ESCI measured value returns to within normal limits. When the value in the confidence count

e. Execute Boolean operators.

f. Execute operations based on counters and timers.

3.2.2.9. Fault Isolation Characteristics. The ERMS software system shall provide the following data processing for display; and data retrieval, analysis, and reporting functions for ERMS fault isolation:

a. The cell controller shall [1] maintain in computer memory the status of each ESCI and cell controller system diagnostic message that is currently generating an alert or alarm value. Upon request from the MPS and PMDT the cell controller shall [2] output for display the ESCI name, ESCI value, ESCI threshold value exceeded, and date and time of initial occurrence; system diagnostic messages shall [3] be similarly output for display.

b. The cell controller shall [1] provide a History of Alarms report with inclusive from and to dates and times input from the MPS and PMDT. Alarm data shall [2] be available for the preceding 100 events.

c. The cell controller shall [1] provide a History of E/G Start report with inclusive from and to dates input from the MPS and PMDT. Start data shall [2] be available for the preceding 100 starts.

d. The cell controller shall [1] provide a History of Control Activities report by unit controlled, type of action, time, and date. Data shall [2] be available for the preceding 100 events.

e. The cell controller shall provide a Report of Average Analog Values for from one to all ESCIs, for up to 100 hours.

f. The cell controller shall provide a Report of Digital Events by ESCI, time, and date for the preceding 100 events.

g. The cell controller shall provide a Report of a selected analog ESCI value with update every second.

h. The cell controller shall [1] provide a report of Commercial Power Failure, including date, time and duration by month and year. Data shall [2] be available for the preceding 100 events.

i. The cell controller shall [1] provide a Report of E/G Failure to Start, to include date and time, by

month and year. Data shall [2] be available for the preceding 100 events.

j. The cell controller shall [1] provide a Report of Facility Average kW and kWh Electrical Power Consumption, by month and annually, including peak value and minimum values. Values shall [2] be derived from a computation using input voltage, phase currents, and a power factor constant provided during SITEGEN.

k. The cell controller shall provide the following values in a consolidated report:

1. E/G cumulative run time in hours and tenths.
2. E/G run time (last run) in hours and tenths.
3. E/G cranking time in seconds for the last two start events.
4. E/G operations per month and annually.

3.2.3. ERMS Sensor Configuration Item (ESCI) Characteristics
All ESCIs shall meet or exceed the requirements as specified in the following Tables and Sections:

TABLE V
ERMS ESCI OUTPUT MEASUREMENT CRITERIA

ESCI NUMBER	ESCI TYPE	ETE ACCURACY	ETE RESPONSE TIME
001	ac VOLTAGE	±3.0 Vac	0.5 SEC./VOLT
002	ALTERNATING CURRENT 0-100 AMPS ± 5 AMP	±3.0 AMP	0.5 SEC./AMP.
002	ALTERNATING CURRENT 0-400 AMPS ±20 AMP	±8.0 AMP	0.05 SEC./AMP.
007	LIQUID FUEL QUANTITY 0 - 2,000 GALLONS	±5.0 GAL	3.0 SEC./GAL.
007	LIQUID FUEL QUANTITY 0 - 5,000 GALLONS	±8.0 GAL	30.0 SEC./GAL.
007	LIQUID FUEL QUANTITY 0 - 10,000 GALLONS	±10.0 GAL	60.0 SEC./GAL.
008	dc VOLTAGE	±0.05 Vdc	1.0 SEC./VOLT
010	LIQUID PRESSURE	±1.0 psig	1.0 SEC./LB.
011	ac FREQUENCY	±0.3 HZ.	0.16 SEC./HZ.
012	LIQUID TEMPERATURE	±2.0° F	5.0 SEC./°F
013	AIR TEMPERATURE	±2.0° F	5.0 SEC./°F
014	AIR TEMPERATURE	±2.0° F	5.0 SEC./°F
015	AIR TEMPERATURE	±2.0° F	5.0 SEC./°F
025	DIRECT CURRENT	±3.0 AMPS.	3.0 SEC./AMP.

ETE ACCURACY = end-to-end accuracy: The degree to which the output value measured at Interface 1 or 2 may be allowed to deviate from the actual value being measured by the ESCI; specifies the maximum allowable error from all sources.

ETE RESPONSE TIME = end-to-end response time: The maximum time differential that may exist between the occurrence of a value change and the appearance of that value change at Interface 1 or 2

month and year. Data shall [2] be available for the preceding 100 events.

j. The cell controller shall [1] provide a Report of Facility Average kW and kWh Electrical Power Consumption, by month and annually, including peak value and minimum values. Values shall [2] be derived from a computation using input voltage, phase currents, and a power factor constant provided during SITEGEN.

k. The cell controller shall provide the following values in a consolidated report:

1. E/G cumulative run time in hours and tenths.
2. E/G run time (last run) in hours and tenths.
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002	ALTERNATING CURRENT 0-100 AMPS ± 5 AMP	±3.0 AMP	0.5 SEC./AMP.
002	ALTERNATING CURRENT 0-400 AMPS ±20 AMP	±8.0 AMP	0.05 SEC./AMP.
007	LIQUID FUEL QUANTITY 0 - 2,000 GALLONS	±5.0 GAL	3.0 SEC./GAL.
007	LIQUID FUEL QUANTITY 0 - 5,000 GALLONS	±8.0 GAL	30.0 SEC./GAL.
007	LIQUID FUEL QUANTITY 0 - 10,000 GALLONS	±10.0 GAL	60.0 SEC./GAL.
008	dc VOLTAGE	±0.05 Vdc	1.0 SEC./VOLT
010	LIQUID PRESSURE	±1.0 psig	1.0 SEC./LB.
011	ac FREQUENCY	±0.3 HZ.	0.16 SEC./HZ.
012	LIQUID TEMPERATURE	±2.0° F	5.0 SEC./°F
013	AIR TEMPERATURE	±2.0° F	5.0 SEC./°F
014	AIR TEMPERATURE	±2.0° F	5.0 SEC./°F
015	AIR TEMPERATURE	±2.0° F	5.0 SEC./°F
025	DIRECT CURRENT	±3.0 AMPS.	3.0 SEC./AMP.

ETE ACCURACY = end-to-end accuracy: The degree to which the output value measured at Interface 1 or 2 may be allowed to deviate from the actual value being measured by the ESCI; specifies the maximum allowable error from all sources.

ETE RESPONSE TIME = end-to-end response time: The maximum time differential that may exist between the occurrence of a value change and the appearance of that value change at Interface 1 or 2

3.2.3.2. Commercial and E/G Phase or Backup Battery Current ESCI. The phase load current ESCI shall be used to monitor the phase load current in each phase of a three phase system, or line of a single phase system. The following characteristics shall apply:

PHYSICAL CHARACTERISTICS

a. Design shall [1] be removable yoke type or module assembly not exceeding the physical dimensions of L=6", W=4", D=1" with a connector or socket for termination and shall [2] be replaceable using common hand tools.

b. Provisions shall be made for mechanical type fasteners to be employed to securely mount the module assembly.

c. Sensor installation shall not require the disconnection of circuits being monitored.

ELECTRICAL CHARACTERISTICS

d. Two ESCI types are required: 0-100 amperes and 0-400 amperes capable of measuring ac and dc current.

e. The supply voltage to the ESCI shall not exceed 24 Vdc.

f. The output voltage shall be proportional to the sensed current of from 0 Vdc to 5 Vdc (±0.5%) over the current range to be measured.

ADJUSTMENT

g. The ESCI module shall have offset voltage and current sensitivity adjustments.

3.2.3.3. Oil Level ESCI. The oil level ESCI shall provide the user with information on the level of the oil in the sump or pan of the E/G. The following characteristics shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI shall withstand and operate under the following vibration conditions:

Displacement and Acceleration	Frequency (HZ)
0.20"	0 - 10
0.04"	10 - 50
3.0 Gs	50 - 500

b. The ESCI shall be chemically inert to petroleum based lubricants.

c. The ESCI physical dimensions shall not exceed L=10", W=4", D=3".

d. The ESCI shall [1] be mounted to the engine block using the existing oil sump drain (see Appendix III, Figure 7) and shall [2] function on both vented and nonvented crankcases.

ELECTRICAL CHARACTERISTICS

e. The ESCI shall [1] have both an upper and lower oil level switch contacts which shall [2] be rated at a minimum of 2 amps at 24 Vac/dc resistive.

f. The contact switch arrangement shall have one common and two isolated NORMALLY OPEN contacts.

g. The switch contacts shall range from NORMALLY OPEN to CLOSED with activation by oil level variation.

ADJUSTMENT

h. The upper and lower oil level contacts must be adjustable through a 6" range.

3.2.3.4. Engine Coolant Level ESCI. This ESCI shall measure the level of the coolant in the E/G radiator when the engine is not running by measurement of differential pressure. The following ESCI characteristics shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI shall [1] be mounted on the existing E/G coolant drain device (see Appendix III, Figure 3) and shall [2] not interfere with the normal operation of that device. Connection shall be via a 1/8" to 3/8" diameter pipe.

b. ESCI installation shall [1] be of light weight piping, supported by the radiator frame. The ESCI shall [2] be mounted so as to be 3/8" to 1/2" above the radiator full fluid level in the radiator core. ESCI and associated plumbing shall be constructed of corrosion-resistant materials that shall [3] be chemically inert to water and antifreeze cooling fluids.

c. The internal pressure diaphragm shall [1] withstand a maximum pressure of 350 psig, and shall [2] have an operating pressure not exceeding 200 psig.

b. The ESCI shall be chemically inert to petroleum based lubricants.

c. The ESCI physical dimensions shall not exceed L=10", W=4", D=3".

d. The ESCI shall [1] be mounted to the engine block using the existing oil sump drain (see Appendix III, Figure 7) and shall [2] function on both vented and nonvented crankcases.

ELECTRICAL CHARACTERISTICS

e. The ESCI shall [1] have both an upper and lower oil level switch contacts which shall [2] be rated at a minimum of 2 amps at 24 Vac/dc resistive.

f. The contact switch arrangement shall have one common and two isolated NORMALLY OPEN contacts.

g. The switch contacts shall range from NORMALLY OPEN to CLOSED with activation by oil level variation.

ADJUSTMENT

h. The upper and lower oil level contacts must be adjustable through a 6" range.

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c. The internal pressure diaphragm shall [1] withstand a maximum pressure of 350 psig, and shall [2] have an operating pressure not exceeding 200 psig.

ELECTRICAL CHARACTERISTICS

f. The ESCI microswitch contacts shall be SPST N.O., rated at a minimum of 3 amps and 24 Vac/Vdc.

ADJUSTMENT

g. The ESCI shall be adjustable by positioning the airvane-microswitch unit for switch closure with a positive airflow force of .5 meters/sec ±.1 m/s

3.2.3.6. Ventilator Louver Position ESCI(s). The E/G room and other ventilator louver position ESCIs shall [1] consist of N.O., SPST, magnetically actuated switches. They shall [2] provide positive indication of the position(s) of the ventilator louver(s). The ESCIs shall [3] provide the basis for an alarm when the louvers fail to open when the E/G is running and with the E/G room door closed. The ESCIs shall meet the following characteristics;

PHYSICAL CHARACTERISTICS

a. The ESCI shall consist of two separate housings, one for the magnetic actuator, and one for the switch contacts.

b. The assemblies shall provide for mounting using mechanical screw type mounting devices.

c. The switch housing device shall have #22 AWG leads that are a minimum of 6" in length.

d. Slot type adjustment openings shall be provided in the screw type mounting devices.

e. The ESCI shall have physical dimensions not exceeding L=3", W=2", D=1".

f. The ESCI shall require only simple hand tools for adjustment or replacement.

ELECTRICAL CHARACTERISTICS

g. The switch contacts shall be rated for a minimum of 24 Vac/Vdc and a minimum of 1 amp.

h. The switch contacts shall [1] be N.O. SPST and shall [2] operate in any spatial orientation.

ADJUSTMENT

i. No calibration shall [1] be required. The adjustment procedure shall [2] consist of mounting the two assemblies in proper relation to the pivot

point of the sensed object. Minor sensitivity adjustments shall [3] be accomplished by slot adjustment provided by the mounting device.

3.2.3.7 Fuel Tank Level ESCI. The fuel tank level ESCI for gasoline or diesel fuel shall [1] consist of a pressure transducer in a bubbler-type system. It shall [2] provide alarm points at two or more fuel levels (see Para. 3.1.5.2.9.). A small, single cylinder electrically driven air compressor shall [3] be used to supply air for the bubbler system. It shall [4] be provided with a small reserve air tank to reduce the number of compressor operations. The following ESCI characteristics shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI technology shall employ a hybrid, differential, pressure transducer(s) to measure and quantify the static head pressure at the bottom of a given fuel tank.

b. The ESCI shall [1] be mounted external to the fuel system inside the facility E/G room (see Appendix III, Figure 5) and shall [2] measure hydrostatic pressures from 0.01" Hg. to 7.0" Hg. ± .005" Hg.

c. The maximum physical dimensions of the pressure transducer shall be L=5", W=3", D=3".

d. The ESCI shall [1] be connected to the base of the fuel tank by a non conductive, petroleum inert flexible tubing (dia. ¼" to 3/8"). This tubing shall [2] be used to develop the static pressure (static head) on one port of the differential ESCI. The other port shall [3] be vented to the atmosphere.

e. The maximum physical dimensions of the air compressor shall [1] not exceed L=16, W=12", D=12", and 20 lbs in weight. The compressor and air tank shall [2] be mountable in any spatial attitude and shall [3] be provided with mounting brackets for floor or wall mounting. The compressor shall meet the following additional characteristics:

1. Oil-less, non-lube piston and cylinder.

2. Permanently lubricated ball bearings.

3. Stainless steel valves.

4. Lapped aluminum valve plates and intake filter.

point of the sensed object. Minor sensitivity adjustments shall [3] be accomplished by slot adjustment provided by the mounting device.

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b. The ESCI shall [1] be mounted external to the fuel system inside the facility E/G room (see Appendix III, Figure 5) and shall [2] measure hydrostatic pressures from 0.01" Hg. to 7.0" Hg. ± .005" Hg.

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1. Oil-less, non-lube piston and cylinder.

2. Permanently lubricated ball bearings.

3. Stainless steel valves.

4. Lapped aluminum valve plates and intake filter.

PHYSICAL CHARACTERISTICS

a. The physical size of the ESCI shall not exceed L=2",W=1" , D=1" .

b. The ESCI shall be modular with holes for mounting to a stable surface with mechanical fasteners and stand-offs.

c. The ESCI shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

d. Output voltage shall [1] be a linear representation of the measured voltage range of 0-50 Vdc. Supply current shall [2] not exceed 1 ma.

ADJUSTMENT

e. No adjustment of the ESCI shall be required.

3.2.3.9. E/G-Commercial Power Transfer Switch Position ESCI. This ESCI shall [1] consist of two switches whose positions shall [2] be monitored to provide information about the actual position of the transfer switch, i.e., COMMERCIAL POWER, INTERMEDIATE, or E/G POWER. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The auxiliary switch shall be ASCO 249-322 or equal.

b. The physical size of the ESCI shall not exceed L=8", W=8", D=4".

c. The ESCI shall be mounted inline with the transfer switch and actuated by movement of the transfer switch.

d. The two auxiliary switches shall each have a NC contact that is mechanically actuated.

ELECTRICAL CHARACTERISTICS

e. The ESCI switch contacts shall be rated for a minimum of 3 amps at 24 Vac/Vdc.

ADJUSTMENT

f. No calibration shall [1] be required. The switches shall [2] be adjustable to operate within the actuating range of the transfer switch.

PHYSICAL CHARACTERISTICS

a. The physical size of the ESCI shall not exceed L=2",W=1" , D=1" .

b. The ESCI shall be modular with holes for mounting to a stable surface with mechanical fasteners and stand-offs.

c. The ESCI shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

d. Output voltage shall [1] be a linear representation of the measured voltage range of 0-50 Vdc. Supply current shall [2] not exceed 1 ma.

ADJUSTMENT

e. No adjustment of the ESCI shall be required.

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d. The two auxiliary switches shall each have a NC contact that is mechanically actuated.

ELECTRICAL CHARACTERISTICS

e. The ESCI switch contacts shall be rated for a minimum of 3 amps at 24 Vac/Vdc.

ADJUSTMENT

f. No calibration shall [1] be required. The switches shall [2] be adjustable to operate within the actuating range of the transfer switch.

PHYSICAL CHARACTERISTICS

a The physical size of the ESCI shall not exceed L=6", W=4", D=3".

b. The ESCI shall [1] be modular and shall [2] have provisions for mounting on a stable surface with standoff insulators.

c. The ESCI shall require only simple hand tools for positioning or replacement.

d. Mechanical screw-type fasteners shall be used to securely fasten the ESCI when mounting.

e. The ESCI operation shall not be affected by it's mounting attitude.

ELECTRICAL CHARACTERISTICS

f. The ESCI shall accept input signal ranges between 55 Hz. and 65 Hz.

g. The ESCI shall supply a proportional 0 - 8 Vdc voltage to the cell controller analog channel with a residual ac ripple of 2 mv.

h. The output response time for the ESCI shall be 0.16 seconds per Hz.

i. The ESCI shall be temperature compensated to insure 0.001% output accuracy over facility temperature range as specified in TABLE I.

ADJUSTMENT

j. No adjustment shall be required.

3.2.3.12. E/G Coolant Temperature ESCI. The E/G coolant temperature ESCI shall [1] monitor the E/G block temperature. The cell controller shall [2] provide alarms and alerts when both over temperature and under temperature conditions exist. The output of the ESCI shall [3] be a dc voltage proportional to the temperature. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The physical size of the ESCI shall not exceed L=1.5", W=1", D=1".

b. The ESCI housing shall [1] be attachable to the engine coolant manifold using an existing engine coolant manifold bolt (see Appendix III, Figure 8). The mounting hole size shall [2] be 0.5" in diameter.

c. The ESCI shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

d. The ESCI shall measure temperatures in the range 32°F to 266°F.

e. The ESCI shall have a temperature coefficient of 0.00375 to 0.00392 ohm per ohm per °C.

f. The ESCI shall be supplied with a minimum three foot length of 2 conductor #24 AWG stranded wire in a metallic protective sheath.

ADJUSTMENT

g. Adjustment of the ESCI shall not be required.

3.2.3.13. Room Temperature ESCI. Engine and equipment room temperatures shall [1] be monitored. The ESCI shall [2] output a dc voltage that is proportional to the temperature value being measured, The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The physical size of the ESCI shall not exceed L=5", W=3", D=1".

b. Each ESCI housing shall be mountable on a standard electrical outlet box (Handi-box) or directly on a wall surface.

c. Mechanical screw-type fasteners shall be employed for mounting that can be easily installed or removed using common hand tools.

ELECTRICAL CHARACTERISTICS

d. The ESCI shall measure temperatures between 5°F and 131°F.

e. The ESCI shall have a temperature coefficient of between 0.00375 and 0.00392 ohm per ohm per °C.

ADJUSTMENT

f. No ESCI adjustment shall be required.

3.2.3.14. Supply and Return Air Temperature ESCI for Heating and Air Conditioning. Environmental conditioning equipment supply and return air temperatures shall [1] be monitored to determine

c. The ESCI shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

d. The ESCI shall measure temperatures in the range 32°F to 266°F.

e. The ESCI shall have a temperature coefficient of 0.00375 to 0.00392 ohm per ohm per °C.

f. The ESCI shall be supplied with a minimum three foot length of 2 conductor #24 AWG stranded wire in a metallic protective sheath.

ADJUSTMENT

g. Adjustment of the ESCI shall not be required.

3.2.3.13. Room Temperature ESCI. Engine and equipment room temperatures shall [1] be monitored. The ESCI shall [2] output a dc voltage that is proportional to the temperature value being measured, The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The physical size of the ESCI shall not exceed L=5", W=3", D=1".

b. Each ESCI housing shall be mountable on a standard electrical outlet box (Handi-box) or directly on a wall surface.

c. Mechanical screw-type fasteners shall be employed for mounting that can be easily installed or removed using common hand tools.

ELECTRICAL CHARACTERISTICS

d. The ESCI shall measure temperatures between 5°F and 131°F.

e. The ESCI shall have a temperature coefficient of between 0.00375 and 0.00392 ohm per ohm per °C.

ADJUSTMENT

f. No ESCI adjustment shall be required.

3.2.3.14. Supply and Return Air Temperature ESCI for Heating and Air Conditioning. Environmental conditioning equipment supply and return air temperatures shall [1] be monitored to determine

d. The ESCI shall have a temperature coefficient of between 0.00375 and 0.00392 ohm per ohm per °C.

ADJUSTMENT

e. No ESCI adjustment shall be required.

3.2.3.16. Airflow ESCI(s) for HVAC(s), Heater(s), Ventilator(s) and Air Conditioner(s). Air movement shall [1] be determined through the use of a properly positioned micro-switch and vane arrangement or functionally similar device (see Appendix III, Figure 4). This ESCI shall [2] be mounted directly in the path of the airflow. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. This ESCI shall be securely mounted by mechanical means in the direct flow of air through the HVAC or heating system, air conditioning, and ventilator system ducts.

b. The physical size of the ESCI shall not exceed L=3", W=2", D=2".

c. An adjustment bracket shall be provided for mounting the ESCI air vane vertically in a horizontal duct.

d. The air vane shall be mounted in the air flow a minimum of 2" from the wall of the duct.

e. The ESCI shall require only simple hand tools for positioning or replacement.

f. The air vane shall [1] activate the electrical contacts to the CLOSED position when a positive air flow of 0.5 Meters per second ±0.1 Mps is exerted on the center of the airvane. A spring shall [2] return the microswitch contacts to the OPEN position in the absence of airflow.

ELECTRICAL CHARACTERISTICS

g. Switch contacts shall [1] be N.O., switch type shall be SPST and shall [2] be rated for a minimum of 3 amps at 24 Vac/Vdc.

ADJUSTMENT

h. The ESCI shall be adjustable by positioning the air vane-micro-switch arrangement for switch closure at a specific airflow velocity.

3.2.3.17. Fire and Smoke Detection ESCIs. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI shall mount on a standard 4" X 4" electrical outlet box.

b. The physical size of the ESCI shall not exceed L=8", W=8", D=4".

c. The ESCI shall be mounted at the ceiling not less than 6" from an outside wall.

d. The ESCI shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

e. The ESCI shall be of the ionization type.

f. The alarm relay contactsshall be rated for a minimum of 1.0 amp at 30 Vdc.

g. The contacts shall be N.O., SPST type.

h. The power supply to the ESCI shall be 5 Vdc to 24 Vdc.

ADJUSTMENT

i. No ESCI adjustment shall be required.

3.2.3.18. Intrusion ESCI(s). The intrusion ESCI (or ESCI set) shall [1] be used to detect the position of doors and the integrity of windows and other openings. A ESCI shall [2] be installed on each door, window, and other opening. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI(s) shall be of the type appropriate to the opening being monitored e.g., two piece magnetic switch for doors, foil tape for windows, microswitch for duct openings.

b. The switch type ESCI assemblies shall [1] have mechanical screw type mounting devices. Slot type adjustment shall [2] be provided in the screw type mounting devices.

c. The ESCI(s) shall require only simple hand tools for positioning or replacement.

3.2.3.17. Fire and Smoke Detection ESCIs. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI shall mount on a standard 4" X 4" electrical outlet box.

b. The physical size of the ESCI shall not exceed L=8", W=8", D=4".

c. The ESCI shall be mounted at the ceiling not less than 6" from an outside wall.

d. The ESCI shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

e. The ESCI shall be of the ionization type.

f. The alarm relay contactsshall be rated for a minimum of 1.0 amp at 30 Vdc.

g. The contacts shall be N.O., SPST type.

h. The power supply to the ESCI shall be 5 Vdc to 24 Vdc.

ADJUSTMENT

i. No ESCI adjustment shall be required.

3.2.3.18. Intrusion ESCI(s). The intrusion ESCI (or ESCI set) shall [1] be used to detect the position of doors and the integrity of windows and other openings. A ESCI shall [2] be installed on each door, window, and other opening. The following ESCI specifications shall apply:

PHYSICAL CHARACTERISTICS

a. The ESCI(s) shall be of the type appropriate to the opening being monitored e.g., two piece magnetic switch for doors, foil tape for windows, microswitch for duct openings.

b. The switch type ESCI assemblies shall [1] have mechanical screw type mounting devices. Slot type adjustment shall [2] be provided in the screw type mounting devices.

c. The ESCI(s) shall require only simple hand tools for positioning or replacement.

#24 AWG wire between the lockout switch relay and the cell controller. The circuit shall [2] be wired in parallel with the relay to permit a maximum of 37/Vdc @ 500 ma at the cell controller input port. Activation of the lockout switch (3) shall provide an ESCI sense voltage to the cell controller.

ADJUSTMENT

d. No lockout switch ESCI adjustment shall be required.

3.2.3.20. Obstruction Light Monitor ESCI. There may be one or more obstruction lights at one facility. The obstruction lights and their on/off photocell or timer shall [1] be monitored by the cell controller which shall [2] generate an alarm when the lights are on and one or more lights have failed. One current ESCI module shall [3] monitor one or more obstruction lights. The load wire from the circuit breaker to the obstruction lights shall [4] be re-routed through the current transducer on the current-sensing module . A parallel circuit shall [5] be created using output of the obstruction light photocell or timer switch circuit as input to the cell controller for determining obstruction light ON condition. The output of both devices shall [6] be sent to the cell controller interface. The processor shall [7] process an alert for display whenever the lights are receiving an ON command from the photocell or timer and the ESCI indicates a reduced current from that entered during SITEGEN.

PHYSICAL CHARACTERISTICS

a. The monitor shall be of modular construction (module assembly) with a connector or socket for termination.

b. Mechanical type fasteners shall be employed to securely mount the module assembly.

c. A module assembly size shall not exceed L=6, W=4, D=1 inches.

ELECTRICAL CHARACTERISTICS

d. The D.C. current output of the ESCI shall be directly proportional to the A.C. current input.

e. The sensed current level shall not exceed 15 amperes.

f. The supply voltage to the ESCI shall not exceed 24 Vdc.

#24 AWG wire between the lockout switch relay and the cell controller. The circuit shall [2] be wired in parallel with the relay to permit a maximum of 37/Vdc @ 500 ma at the cell controller input port. Activation of the lockout switch (3) shall provide an ESCI sense voltage to the cell controller.

ADJUSTMENT

d. No lockout switch ESCI adjustment shall be required.

3.2.3.20. Obstruction Light Monitor ESCI. There may be one or more obstruction lights at one facility. The obstruction lights and their on/off photocell or timer shall [1] be monitored by the cell controller which shall [2] generate an alarm when the lights are on and one or more lights have failed. One current ESCI module shall [3] monitor one or more obstruction lights. The load wire from the circuit breaker to the obstruction lights shall [4] be re-routed through the current transducer on the current-sensing module . A parallel circuit shall [5] be created using output of the obstruction light photocell or timer switch circuit as input to the cell controller for determining obstruction light ON condition. The output of both devices shall [6] be sent to the cell controller interface. The processor shall [7] process an alert for display whenever the lights are receiving an ON command from the photocell or timer and the ESCI indicates a reduced current from that entered during SITEGEN.

PHYSICAL CHARACTERISTICS

a. The monitor shall be of modular construction (module assembly) with a connector or socket for termination.

b. Mechanical type fasteners shall be employed to securely mount the module assembly.

c. A module assembly size shall not exceed L=6, W=4, D=1 inches.

ELECTRICAL CHARACTERISTICS

d. The D.C. current output of the ESCI shall be directly proportional to the A.C. current input.

e. The sensed current level shall not exceed 15 amperes.

f. The supply voltage to the ESCI shall not exceed 24 Vdc.

g. The output voltage shall be a linear representation of the input current.

h. Shall have an output voltage of from 1 Vdc to 5 Vdc (±0.5%) over the current range to be measured.

ADJUSTMENT

i. The ESCI module shall have offset voltage and current sensitivity adjustments.

3.2.4. ERMS Control Function ESCIs: The ERMS shall provide control, remotely, to one or more of the various facility environmental equipment types through the use of ERMS operational functions. These functions are:

1. Remote E/G start/stop
2. Remote heating system start/stop
3. Remote ventilation system start/stop
4. Remote air conditioning system start/stop
5. Remote HVAC system start/stop

PHYSICAL CHARACTERISTICS

a. All control relay(s) shall operate in an ambient air temperature between -40°F to 176°F.

b. The control relay(s) shall be a totally enclosed, octal socket mounted, general purpose relay designed for harsh environment.

c. The physical size of the relay(s) shall not exceed L=3", W=2", D=2".

d. The octal socket shall be securely fastened with mechanical fasteners inside the environmental conditioning unit adjacent to the equipment start/stop relay.

e. The relay shall be operate in any spatial orientation.

f. The relay shall require only simple hand tools for positioning or replacement.

ELECTRICAL CHARACTERISTICS

g. The control relay contacts shall be rated for a maximum of 10 amperes at 240 Vac. (NE CODE CLASS 2).

h. The relay coil shall be rated at 50 ma at 24 Vdc.

ADJUSTMENT

i. No relay adjustment shall be required.

3.3. Data Processins Resources. Data processing resources shall consist of the cell controller, PMDT (to be furnished by the Government), and associated software, and supporting equipment.

3.3.1. Computer Hardware Requirements. Refer to Section 3.2.2.

3.3.2. Programming Requirements. Standards of programming as defined in FAA-STD-026, NAS Software Development shall apply.

3.3.3. Design and Coding Constraints. Design and coding shall be constrained as follows:

a. Structured, modular code techniques using subroutine calls shall [1] be used to the maximum extent provided by the programming language(s). All modules shall be implemented with one entry and one exit with the exception of error conditions and shall [2] be written using only the following control constructs: SEQUENCE, IF-THEN-ELSE, DO-WHILE, DO-UNTIL, CASE, FOR, and BREAK (or their symbolic equivalents) to the extent that they are supported by the programming language.

b. Code modules and subroutines shall [1] be functionally discrete and shall [2] perform all logical actions required by the function using not more than 300 lines of executable program code.

c. Each module and subroutine shall be internally documented to describe its specific functions.

3.3.4. Electromagnetic Interference (EMI). The ERMS shall meet the requirements of FAA-STD-020 and MIL-STD-461 to minimize the generation of and susceptibility to electromagnetic interference.

3.4. Documentation. Documentation shall be prepared in accordance with the standards specified herein and as identified in the Contract Data Requirements Lists (CDRLs).

3.4.1. Engineering Documentation. ERMS Engineering documentation shall be prepared in accordance with FAA-STD-005 for specifications and in accordance with DOD-D-1000 and DOD-STD-100 for engineering drawings.

ADJUSTMENT

i. No relay adjustment shall be required.

3.3. Data Processins Resources. Data processing resources shall consist of the cell controller, PMDT (to be furnished by the Government), and associated software, and supporting equipment.

3.3.1. Computer Hardware Requirements. Refer to Section 3.2.2.

3.3.2. Programming Requirements. Standards of programming as defined in FAA-STD-026, NAS Software Development shall apply.

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a. Structured, modular code techniques using subroutine calls shall [1] be used to the maximum extent provided by the programming language(s). All modules shall be implemented with one entry and one exit with the exception of error conditions and shall [2] be written using only the following control constructs: SEQUENCE, IF-THEN-ELSE, DO-WHILE, DO-UNTIL, CASE, FOR, and BREAK (or their symbolic equivalents) to the extent that they are supported by the programming language.

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3.4.1. Engineering Documentation. ERMS Engineering documentation shall be prepared in accordance with FAA-STD-005 for specifications and in accordance with DOD-D-1000 and DOD-STD-100 for engineering drawings.

notices (DCNs) required to modify supply support documentation. Lists prepared in hard copy shall be formatted in accordance with specification FAA-G-1375 for spare parts-peculiar and MIL-STD-1561 for all other lists. Item identification data and DCNs prepared in hard copy shall [2] be formatted in accordance with MIL-STD-1561. Lists developed from logistics support analysis (LSA) shall [3] be formatted in accordance with MIL-STD-1388-2 and documented in an automated media compatible with FAA LSA automated data bases.

3.4.5.2. Maintenance Documentation. Maintenance documentation for ERMS includes the sequential task descriptions generated during LSA and used to identify LRUs and the level or repair data used in exercising the Repair Level Analysis (RLA) model. Sequential task description and RLA data as appropriate shall be formatted in accordance with MIL-STD-1388-2 and documented in an automated media compatible with the FAA LSA automated data base.

3.4.5.3. Technical Publications. Technical instruction books shall [1] be developed by the contractor in accordance with FAA-D-2494 and shall [2] include the following documents:

a. ERMS INSTALLATION MANUAL. This manual shall [3] describe the step-by-step processes by which each ERMS component will be installed in a typical facility environment. ERMS components shall [4] consist of data communications equipment (DCE), cell controller equipment, UPS equipment, power supply, ESCIs, ESCI interfaces, and all associated cabling for power and communications. The manual shall [5] contain a section detailing comprehensive test processes and documentation required to determine proper ERMS function after installation. The manual shall [6] identify all test equipment required and shall [7] describe the function and use of each. The manual shall [8] describe processes for less than full function ERMS installations.

b. ERMS MAINTENANCE MANUAL. This manual shall [9] describe the functional, operational, and component level maintenance procedures for hardware and software fault detection, fault isolation, and component/ module repair/replacement. The manual shall [10] include step-by-step diagnostic procedures that will permit reliable fault isolation in the field environment. The manual shall [11] interface with the manufacturer's specifications and diagnostic descriptions for all off-the-shelf equipment.

3.4.5.4. Logistics Documentation. Provisioning Technical Documentation (PTD) shall [1] be developed in accordance with MIL-STD-1561 (provisioning). Data from PTD required to be automated shall [2] be formatted in accordance with

MIL-STD-1388-2. A documentation package shall [3] be developed for each repairable line replaceable unit (LRU) comprised of drawings to the piece part level, procedures outlining repair for each LRU's failure mode, and certification of repair.

3.4.6. Training and Training Equipment Documentation. The contractor shall [1] prepare a written training plan outlining the required courses, attendance requirements, course length, and supporting training equipment requirements for the ERMS subsystem. This plan shall [2] be in accordance with FAA-STD-028 as implemented by the statement of work.

3.4.7. Quality Control Documentation. See Section 4 of this document. Quality control (QC) documentation shall be prepared, by the contractor, in accordance with FAA-STD-013.

3.4.8. Test and Evaluation Documentation. Test and evaluation (T & E) documentation shall be prepared in accordance with FAA-STD-024

3.5. Logistics. Parts-peculiar materiel shall [1] be identified and initial quantities of spares established in accordance with FAA-G-1375. Line Replaceable units shall [2] be classified as repairable using an FAA approved repair level analysis (RLA) model. Range and quantities of spares at each maintenance level shall [3] be developed using the FAA's spares quantification model based on the maintenance policy for each level.

3.5.1. Maintenance. Maintenance of ERMS will be based on removal and replacement of faulty line replaceable units(LRUs).

3.5.1.1. Mean Time Between Failure. ERMS, in its maximum ESCI configuration, shall demonstrate a mean time between failure (MTBF) of 2,800 hours where the word failure means "any event requiring corrective action".

3.5.1.2. Mean Time to Restore. ERMS, in its maximum ESCI configuration, shall demonstrate a mean time to restore (MTTR) of 30 minutes. This includes the time required for fault diagnosis, LRU removal and replacement, and system operational checkout.

3.5.1.3. Preventive Maintenance. ERMS shall, in continuous operation, require preventive maintenance (PM) no more frequently than once each year and shall require no more than 16 hours to accomplish.

3.5.1.4. Software Support System. A software maintenance support system shall [1] be developed. This system shall consist of an integrated, fully documented and organized aggregation of all software support hardware, software, and documentation required to develop and test the ERMS and PMDT software. This system shall [2] be delivered to the Government prior to the delivery of the first production system.

3.5.2. Supply. All spare parts-peculiar will be identified and acquired in accordance with FAA-G-1375. Repairable LRUs shall [1] be identified and spares quantified from data generated by logistic support analysis (LSA) in accordance with MIL-STD-1388-1. Provisioning lists shall [2] be developed from data generated by LSA and formatted in automated media in accordance with MIL-STD-1388-2. Provisioning shall [3] be accomplished in accordance with MIL-STD-1561.

4. Quality Assurance Provisions, General. The ERMS hardware and software shall be developmentally tested and evaluated to assist the engineering design and development process and to verify attainment of technical performance specifications and objectives. The ERMS developmental testing and evaluation (DT&E) shall be based on a bottom-up building block approach that takes a well defined subset of ERMS requirements and validates compliance of that building block with its requirement before proceeding to the next higher level of integration. Major test series shall progress from the unit level to the subsystem level, and thence to the combined subsystem level, and finally to the system test level. Functional capabilities of each successive building block shall increase until the final building block implements all ERMS requirements. In the event of test failure, repeat testing shall be conducted. Regression tests shall be introduced after software or hardware changes have been implemented. Production DT&E shall be conducted in accordance with the test planning requirements of paragraph 4.2.

4.1. Quality Assurance (QA) Program. The contractor shall provide and maintain a total quality assurance and control program, including a software quality program, in accordance with the contract.

4.1.1. ERMS Reliability Criteria. The ERMS shall:

a. Be continuously operable at temperatures and at humidity levels specified in Table I (see 3.1.4.1).

b. Data for the determination of ERMS reliability shall be acquired during all contractor and FAA executed factory, operational, and shakedown testing and shall be used to develop a reliability growth curve using the test, analysis, and fix (TAAF) techniques defined in MIL-STD-781. Demonstrate, through the use of reliability

growth curves, a system mean time between failure (MTBF) of 2,800 hours. Included in this requirement are all ERMS components delivered to the Government.

4.2. Test Planning and Reporting. All aspects of the ERMS testing shall be documented as defined in FAA-STD-024 appendices 2 and 3.

a. Test documentation shall include a Qualification and Acceptance Test Plan (QATP) which shall include test descriptions, test procedures, and test reports to be utilized for unit, subsystem, subsystem integration, and qualification and acceptance. The ERMS test documentation shall be provided and maintained by the contractor.

b. Qualification Test Plans (QTPs) shall describe a structure of test hierarchy and shall specify the policies and objectives of the test program and the organization and methods to be used to ensure that all specifications and lower level derived requirements are met. The plan shall identify the specific tests to be performed, along with a brief description of the tests. In addition, the plan shall show the major test milestones and shall discuss any special test resource requirements. The contractor shall derive the QTP from the Government-provided Verification Requirements Traceability Matrix (VRTM) of Appendix VI. The QTP shall show traceability to the test procedures where demonstration and testing are required by the VRTM in Appendix VI. The contents of the QTP shall clearly describe the necessary tests at the lower Unit level which are required to demonstrate the lack of any defects prior to subsystem-level tests, and the necessary tests at the subsystem and subsystem-integration levels.

4.2.1. Contractor VRTM. For derived requirements, the contractor shall complete the VRTM with the appropriate verification methods, based on the requirements of Section 4. The VRTM establishes the testing levels of the individual requirements of Section 3 to the method of verification (i.e., testing, inspection, analysis, and demonstration). The contractor shall complete the VRTM, by adding the paragraphs of lower level derived requirements, the corresponding verification methods, and the corresponding factory and site tests/procedures to be used to demonstrate compliance and traceability with each VRTM requirement. The contractor shall complete the VRTM for derived requirements, indicated at top level paragraphs by the letter "C". Additionally, for other VRTM requirements for which verification methods have been stipulated by the FAA, the contractor shall indicate in the QTP where previous qualification testing and a certificate of compliance is proposed to be used in lieu of actual testing. The VRTM remarks column shall be used to indicate a paragraph title, a definition,

a description, or any other requirement not requiring verification. The completed VRTM shall be included by the contractor in his QATP.

4.2.2. Software Unit Tests. Software unit tests, software subsystem tests, and the equipment being tested at the unit and subsystem levels, shall be clearly correlated to the system development documentation specified in the software requirements definitions derived by the contractor. Any reference to software in Section 4 also refers to firmware unless otherwise specified. The QTP shall clearly address the testing of all equipment. It shall also clearly address the testing of all interactive functions between commercial-off-the-shelf (COTS) and non-COTS equipment to verify full compatibility and interoperability of the equipment.

4.2.3. Listing of Tests. In general, testing of specification compliance shall be accomplished at the highest test level specified in the VRTM (i.e., system and subsystem). As part of the test planning requirements, the QTP shall contain a list of tests and test approaches for each ERMS requirement specified by the VRTM to be tested, including all related software, and a list of tests and test approaches for the validation of the logical functions of the developmental ERMS software. These tests shall be detailed to such a level that each functional requirement (including error detection, correction, and reporting) is fully tested. These lists shall contain and identify all factory and site tests necessary to test system hardware and software compliance with the requirements of this specification.

4.2.4. LRU Testing. The unit (line replaceable unit) level of the factory design qualification tests (see Section 4.3.2.1) shall be performed by the contractor and witnessed by the Government at its discretion. The Government shall have the right to separately perform any test. All other factory tests and all site tests shall be overseen by the Government and performed by the contractor, with FAA support as required.

4.2.5. Testing Documentation. Test plans, descriptions, procedures, and data sheets for all tests shall meet the requirements of (1) FAA-STD-024, Appendices II and III, for all hardware and COTS software, and (2) FAA-STD-026 for all non-COTS software (see Section 4). The contractor shall deliver all test data and all documentation that refers to factory and site tests. Included in this deliverable item shall be a complete set of all test data generated or acquired from testing, in addition to specific identification of the COTS equipment and software and developmental software that was tested.

4.2.6. Testing Reports and Records. The contractor shall review and analyze all test data and shall report the results in the form of test reports at a time interval according to the contract schedule. As a minimum, the test reports shall contain:

a description, or any other requirement not requiring verification. The completed VRTM shall be included by the contractor in his QATP.

4.2.2. Software Unit Tests. Software unit tests, software subsystem tests, and the equipment being tested at the unit and subsystem levels, shall be clearly correlated to the system development documentation specified in the software requirements definitions derived by the contractor. Any reference to software in Section 4 also refers to firmware unless otherwise specified. The QTP shall clearly address the testing of all equipment. It shall also clearly address the testing of all interactive functions between commercial-off-the-shelf (COTS) and non-COTS equipment to verify full compatibility and interoperability of the equipment.

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4.2.4. LRU Testing. The unit (line replaceable unit) level of the factory design qualification tests (see Section 4.3.2.1) shall be performed by the contractor and witnessed by the Government at its discretion. The Government shall have the right to separately perform any test. All other factory tests and all site tests shall be overseen by the Government and performed by the contractor, with FAA support as required.

4.2.5. Testing Documentation. Test plans, descriptions, procedures, and data sheets for all tests shall meet the requirements of (1) FAA-STD-024, Appendices II and III, for all hardware and COTS software, and (2) FAA-STD-026 for all non-COTS software (see Section 4). The contractor shall deliver all test data and all documentation that refers to factory and site tests. Included in this deliverable item shall be a complete set of all test data generated or acquired from testing, in addition to specific identification of the COTS equipment and software and developmental software that was tested.

4.2.6. Testing Reports and Records. The contractor shall review and analyze all test data and shall report the results in the form of test reports at a time interval according to the contract schedule. As a minimum, the test reports shall contain:

Test equipment interconnection with equipment under test shall be explicitly described in graphic and textual form. Functions, data interfaces, and interactions of test software shall also be clearly defined and identified in the test documentation for each test level. These requirements apply to all classes and levels of testing.

4.3.1. IMCS Confidence Tests. The IMCS confidence tests shall interface the ERMS, via telecommunications, to the remote Maintenance Processor Subsystem (MPS) and to the PMDT for the purpose of validating the software developed by the FAA. This software will be based on the ICD information to be provided by the contractor in response to requirements identified in Appendix IA and IB. Both protocol and application data will be verified as equipment fidelity allows.

4.3.2. Design Qualification Tests. Upon successful completion of the COTS hardware and software tests, the contractor shall perform additional design qualification tests on the first-article(s) units. The complete series of design qualification tests shall verify that the design of the developmental items, and the associated integration with the COTS hardware and software, are properly implemented to meet the requirements of this specification. Custom software shall include all developmental, operational, diagnostic, traffic-simulation, and test software. These tests shall serve two purposes:

a. First, the design qualification tests shall verify that the selected design, regardless of level of implementation, is adequate to fulfill its contribution toward meeting specification requirements. These tests shall verify that allocated function and performance requirements are fully satisfied.

b. Second, the design qualification tests shall verify that the performance of the equipment and software, at all levels of implementation, is adequate to warrant commencement of other planned tests. The design qualification tests may be verified at the sub-unit level or via previous vendor tests with certificates of compliance. Government representatives shall be notified of, and shall be permitted to monitor and observe, the contractor's testing and dry runs of testing that the contractor may conduct in preparation for the unit, subsystem and subsystem integration tests. Such notification shall be provided to the Government at least ten (10) working days prior to the start of such tests or dry runs. The contractor shall describe, in his QTP, the methods by which these tests are to be conducted.

4.3.2.1. Unit Design Tests. Design qualification tests shall be performed on all developmental software in accordance with the

requirements of FAA-STD-026 as tailored by the contract statement of work, and shall involve informal testing activities for unit and computer software components (CSC) (see Section 3.1.4.2).

4.3.2.2. Subsystem Design Tests. After the software packages have been successfully tested at the Unit and CSC levels, they shall be integrated into their appropriate subsystems and formally tested in accordance with the requirements of FAA-STD-026 as tailored by the contract statement of work. The integration and testing shall consist of (1) assembling and integrating the aggregate of CSCIs (see Section 3.1.4.2) of the associated software Units and CSCs with any other developmental and COTS software of the associated subsystem into a unified software Build and (2) verifying all aspects of Build function and performance, including:

a. Incorporation of all the requirements intended for implementation in the software Build.

b. Correctness of all output results.

c. Correctness of all data formats.

d. Proper functioning of all logical paths for all potential contingencies.

e. Conformance to the detailed software design as documented.

f. Proper functioning of internal and external interfaces, using simulated inputs.

Each software build (CSCI or group of CSCIs) shall be tested while executing in the appropriate hardware configuration item (HWCI) or equipment subsystem. Deficiencies discovered during Build testing shall be corrected by the contractor, and the associated correction shall be redelivered in a revised version of the Build or shall be incorporated in the next scheduled Build. Reasons for requiring a revised Build shall include detailed descriptions of problems that impede further testing of the Build and problems that indicate a potentially serious design flaw that must be addressed immediately. The design qualification subsystem tests shall include the regression testing of previously implemented and tested functions to ensure that they have not been compromised by the addition of new functionality. The contractor shall provide all ancillary test equipment, in conjunction with any Government-furnished hardware or software, to demonstrate the input/output external and internal interface-handling operations of the subsystems. Additionally, the contractor shall monitor and report on the actual use of computer resources (i.e., processor time, main memory, mass storage, and input/output channels) of each subsystem. The contractor shall compare the actual consumption of resources to the resource allocations established in the software design.

4.3.3. Reliability Stress Testing and Verification. A complete environmental verification shall be performed on each type of subsystem HWCI. The reliability verification shall consist of stress tests performed to demonstrate compliance with the electrical and environmental specification requirements in Section 3.2.3 and listed in Table I (3.1.4.1), respectively, and shall follow the reliability testing procedures outlined in MIL-STD-781 Appendix B, Category 1 equipment (para. 50.1) and the contract statement of work.

4.3.4. Electromagnetic Interference (EMI) Verification. The contractor shall ensure, during testing, that the ERMS (hardware and software) meets the EMI requirements of Section 3.3.5. The EMI verification shall demonstrate in an organized way that the ERMS equipment is not affected by EMI created by other equipment in the same building or nearby buildings and that the operation of ERMS equipment does not affect the operation of such other equipment. These same EMI requirements shall be applicable during the contractor's site qualification testing.

4.3.5. Reliability, Maintainability, and Availability (RMA) Tests. The contractor shall perform a subset of the RMA tests specified in Section 4.4 The subset of the RMA tests shall consist of tests which demonstrate compliance with the RMA requirements and which are demonstrable during the factory development stage (pre-site testing) of the ERMS.

4.3.6. Factor-v Acceptance Tests (FATs). After successful qualification testing of pre-production ERMS units at the factory, the contractor shall conduct functional and environmental stress testing on all subsequent production ERMS units.

4.4. FAA Tests

4.4.1. First Article Testing. The first article ERMS unit shall be delivered to the Government where qualification site testing shall be accomplished

4.4.1.1. Corrective Maintenance Test(s). The contractor shall perform the corrective maintenance demonstration in accordance with MIL-STD-471, except as modified in this paragraph. The demonstration shall be conducted in a static, non-operational environment and shall include scheduled tasks to be performed in a simple fashion (i.e., pick a task, perform the task, and record the results). The task selections shall be as stated in Appendix A of MIL-STD-471. The statistical corrective maintenance tasks shall have failure modes that have been statistically chosen (see Table II in Appendix A of MIL-STD-471).

a. The contractor shall submit 300 sample corrective maintenance tasks in accordance with Appendix A of MIL-STD-471. The 300 sample tasks shall be included in the QTP description document for the OT&E tests. The Government will randomly select 75 of these tasks for the statistical corrective maintenance demonstration test. The contractor, immediately upon successful completion of the TAAF testing required by Section 4.4.3.2, shall submit in the test report the corrective maintenance tasks for each failure occurring during any testing operation contributing to the development of the ERMS reliability growth curve as defined in MIL-STD-781.

b. From this set of corrective maintenance tasks, and any other corrective maintenance tasks chosen by the Government, the Government will select 25 tasks for the nonstatistical corrective maintenance demonstration.

c. Neither the statistical corrective maintenance demonstration downtime, nor the nonstatistical corrective maintenance demonstration downtime, shall be greater than the corrective maintenance downtime specified in Section 3.2.1.8. During both the statistical corrective maintenance demonstration and the nonstatistical corrective maintenance demonstration, any real equipment failure shall be corrected. Such a failure shall be timed and counted as one of the sample corrective maintenance tasks for the corrective maintenance demonstration in progress at that time. The maintainability demonstration test step in progress shall be considered a failure (simulated or real) if it causes any portion of the system not to meet the performance requirements of this specification, regardless of the outcome of the maintenance demonstration activity. Section 4.4 of MIL-STD- 471 shall be omitted for the purposes of this specification.

4.4.1.2. Demonstration of Fault Isolation Operations. In addition to the static maintainablity demonstration described in paragraph 4.4.1.1, the contractor shall, in a power-up operational configuration, demonstrate the ability of the ERMS to detect, report, and isolate a fault or failure. The contractor shall provide the Government with a list of 75 LRU faults and 15 non-LRU faults which can be introduced into the ERMS. These LRU and non-LRU faults shall be included in the qualification OT&E test plan description document. The Government will select not less than 30 of these faults to be introduced, detected, reported, and isolated via the ERMS. The Government shall also have the right to select up to 25 additional fault conditions to be introduced and detected.

4.4.1.2.1. Maintainability Demonstration Test Log. A chronological test log (included in the test reports) shall be maintained throughout the maintainability demonstration test. This log shall provide the dates and times of all significant events. The following list of events shall be recorded:

a. Power on and power off times of each equipment group.

b. Start and stop times of demonstration testing.

c. Functions, modes, and phases of tests, including random tests.

d. All interruptions of tests, including all failure details.

e. Any unusual conditions in the equipment under test, auxiliary equipment, power sources, or the environment.

4.4.1.3. Software Maintainability Tests. The contractor shall perform a software maintenance test to demonstrate the maintainability of all operational, diagnostic, system support, and test, software and firmware. This test shall demonstrate the speed and ease of software changes and shall be applied to both COTS and custom software. The contractor shall submit 50 sample software maintenance tasks (included in the QTP), excluding changes to system parameters. The samples shall be equally divided among the operational and other types of software, as stated above. The Government will randomly select 15 of these tasks and will add 15 of its own for the software maintainability test.

4.4.2. Retest. Failure of the ERMS equipment to meet specified requirements shall compel the contractor to determine the reason for the noncompliance. The contractor shall be responsible for all corrective actions necessary to ensure full compliance with the specification. The contractor shall complete all repair or rework prior to submission of the equipment for retest. When deficiencies are attributable to software, the contractor shall follow the procedure specified in Section 4.3.2.2 to correct the software deficiency. The Government will determine the extent of retest required. No retest shall be commenced until the contractor has submitted in writing all information concerning the noncompliance(s) and the corrective action(s) taken, including sufficient testing of the repair or rework by the contractor to verify that correct measures were effective prior to submitting the item for Government-witnessed testing. If a review of the reasons for failure to comply with specification requirements indicates that the cause may exist as a latent defect(s) in items previously accepted, the contractor shall be responsible for correcting the defect(s) in all units in a timely manner, even those previously accepted by the Government. In addition, any adjustments made to the equipment during a test shall require that the affected verification process be repeated from the start.

4.5. Verification Methods and Rationale. A verification requirements traceability matrix (VRTM) has been developed, and can be found in Appendix VI. The VRTM couples each of the ERMS requirements to one or more methods of verification. These verification methods shall be mandatory for use in all testing of the ERMS. Failure to pass the appropriate verification action(s) (inspection, analysis, demonstration, or test) shall be cause for rejection. No adjustments to the equipment shall be allowed during verification. When evaluation of the cause of any failure, and implementation of proper corrective measures, have been performed, the verification in which the failure occurred shall be repeated. If the corrective action has an impact on prior verifications (if the software is changed or if any hardware is changed) then the prior verification shall be repeated. Pass/fail success criterion shall be applied to all verification methods, except as defined in the VRTM and in Section 4.6. The following paragraphs describe each of the verification methods and the rationale for selection.

4.5.1. Inspection

4.5.1.1. Hardware Inspection. Inspection of hardware is a method of verification of physical characteristics that determines compliance without the use of special laboratory equipment, procedures, items, or services. Inspection is used to verify construction features, document and drawing compliance, workmanship, and physical condition.

4.5.1.2. Software Inspection. Software inspection is an element of inspection that shall consist of investigation, without the use of special laboratory appliances or procedures, to determine compliance with requirements. This non-destructive examination shall include review of the Software Unit Development Folders (SUDFs) and software source and object listings to verify compliance with software documentation, requirements, and coding standards as well as verification of the implementation of required mathematical equations.

4.5.2. Test

4.5.2.1. Hardware Test. Hardware test is a quantitative method of verification wherein the functions and performance, including RMA, are measured during or after the controlled application of functional and environmental stimuli. Measurements require the use of laboratory equipment, unit and subsystem test drivers, traffic load simulators, procedures, items and services.

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c. Validation of Records Analyses. Validation of records analysis is a method of verification wherein manufacturing records are used to verify compliance of concealed construction features or processes of manufacturing.

4.5.4.2. Software Analyses. Software analysis is an activity taking the form of the processing of accumulated results and conclusions intended to provide proof that the verification of a requirement(s) has been accomplished. The analytical results are composed of interpretation of existing information or derived from lower level tests, demonstrations, analysis, or examinations.

4.5.5. Independent Verification and Validation, Software. Verification and Validation (V&V) testing will be conducted by the Government to ensure that software development is complete, correct, and consistent and that all software requirements have been met. An independent verification and validation (IV&V) organization will be assigned to validate the requirements specifications, design specifications, and production code including all documentation. The IV&V organization will verify the software and will perform independent formal testing of the software subsystem. The IV&V organization will generate the Verification and Validation Plan which details the following for the V&V activity: organization, personnel and responsibilities, schedules, constraints, tools, methods, and activities. The V&V tools, methods, and activities will include the following: requirements analyses, design analyses, code analyses, test reviews, traceability analyses, interface analyses, independent testing, error reporting and tracking, library controls, and configuration management. The contractor shall provide all documentation and software as requested by the Government to support this activity.

5.0. Preparation for Delivery. The contractor shall be responsible for all ERMS equipment packaging, packing, preservation, palletizing, transportation to each installation site, and unpacking at each installation site including those preproduction systems to be used for training, shakedown testing, and integration testing. ERMS delivery shall be complete at the time of Government acceptance of the installed and tested system at each facility.

6.0. Notes

6.1. None.

Appendix IA

10A. OPEN SYSTEMS INTERFACE REQUIREMENTS
Interface 1 - MPS

Appendix IA

10A. OPEN SYSTEMS INTERFACE REQUIREMENTS
Interface 1 - MPS

Appendix IB

10B. OPEN SYSTEMS INTERFACE REQUIREMENTS

Interface 2 - PMDT

Appendix IB

10B. OPEN SYSTEMS INTERFACE REQUIREMENTS

Interface 2 - PMDT

Appendix II

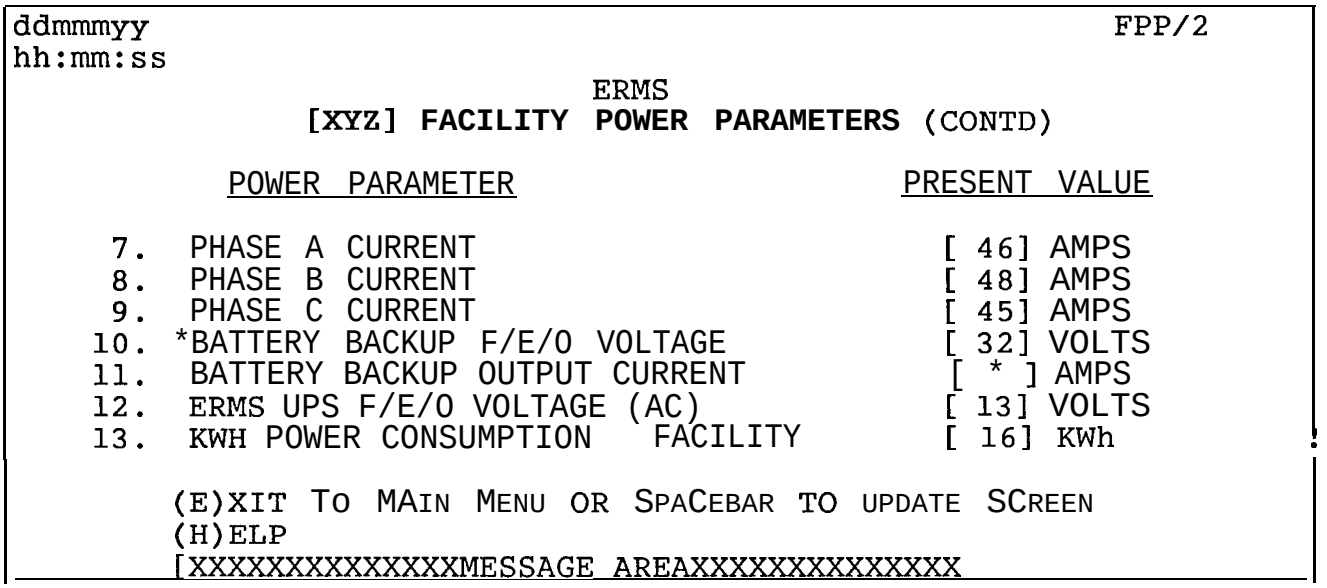
20. SCREEN PRESENTATION OF PARAMETERS

NOTE: All data provided for screen I/O (indicated by [ ]s are examples only and not intended as indicative of actual values.

Appendix II

20. SCREEN PRESENTATION OF PARAMETERS

NOTE: All data provided for screen I/O (indicated by [ ]s are examples only and not intended as indicative of actual values.



* F/E/O = Float/Equalizing/Output
The facility power parameters display function (screen) shall provide the user with a continuously updated display. An associated "HELP" function (screen) shall be available to provide necessary instruction or explanatory notes.

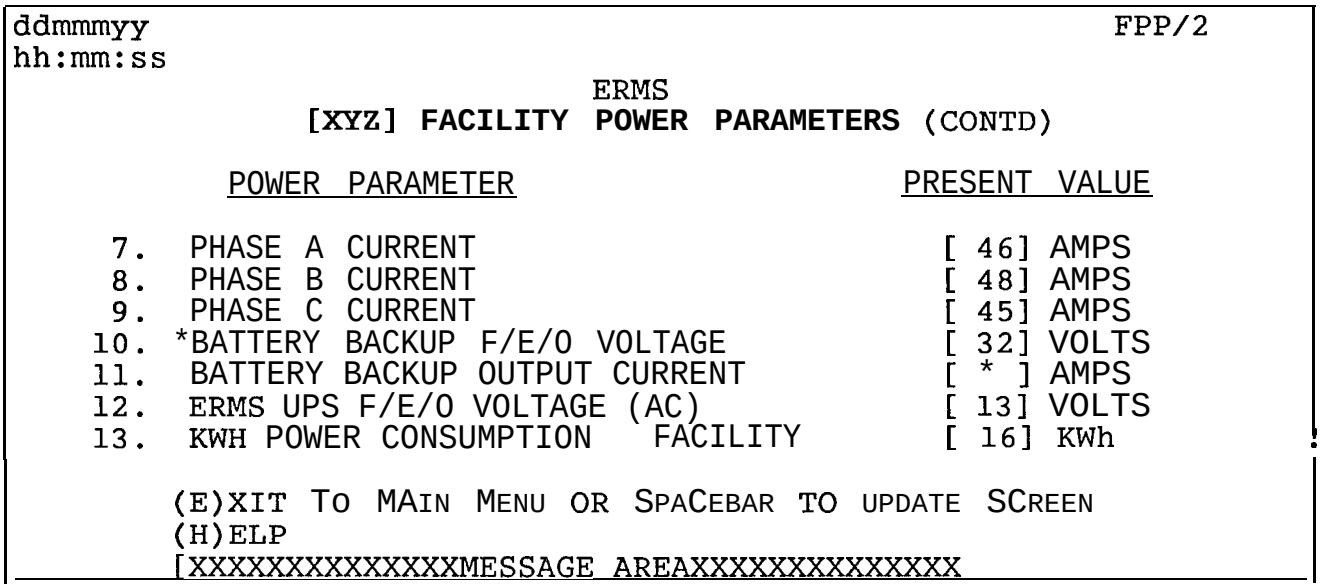
SCREEN PRESENTATIONS SPECIFICATIONS:

All power parameter presentations shall be grouped logically and shall be displayed in volts or amperes rounded off to the nearest unit.

All a.c. voltage measurements on a three phase system, shall be converted and displayed by the cell controller as phase to phase values, if not measured as such.

When a standby system is idle, display a "*" for values.

Note: F/E/O = Float/Equalizing/Output



ddmmmyy FPP/2
hh:mm:ss

ERMS
[XYZ] FACILITY POWER PARAMETERS (CONTD)

	POWER PARAMETER	PRESENT VALUE
7.	PHASE A CURRENT	[46] AMPS
8.	PHASE B CURRENT	[48] AMPS
9.	PHASE C CURRENT	[45] AMPS
10.	*BATTERY BACKUP F/E/O VOLTAGE	[32] VOLTS
11.	BATTERY BACKUP OUTPUT CURRENT	[*] AMPS
12.	ERMS UPS F/E/O VOLTAGE (AC)	[13] VOLTS
13.	KWH POWER CONSUMPTION FACILITY	[16] KWh

(E)XIT To MAin MENU OR SPACEBAR TO UPDATE SCREEN
(H)ELP
[XXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXXX

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When a standby system is idle, display a "*" for values.

Note: F/E/O = Float/Equalizing/Output

E/G PARAMETERS
SCREEN PRESENTATION SPECIFICATIONS

MENU ITEM:

2. After entering "start" command, message area display will indicate "START SEQUENCE INITIATED".
After entering "stop" command, message area display will indicate "STOP SEQUENCE INITIATED". This display will remain on the screen until the ENGINE ON/OFF display shows "OFF" .

3. If the "E/G EMERGENCY STOP SW." is in the "LOCKED OUT" position, the screen message area shall display "E/G LOCKED OUT"

4. In addition to the run time, a date and time group shall be displayed to indicate when E/G last started. A warning alarm shall be initiated when the time of continuous E/G run has reached 4 hours, and shall remain on for the user to acknowledge. This sequence shall be repeated after each 4 hours of continuous operation.

5. Screen presentations shall show current month, total number of E/G runs, and accumulated number of runs since beginning of calendar year.

13. Transfer switch position shall display either "COMMERCIAL" OR "E/G" as appropriate.

16. Oil level shall display normal "NML" or "ALM" for either the STANDBY or RUNNING condition.

E/G PARAMETERS
SCREEN PRESENTATION SPECIFICATIONS

MENU ITEM:

2. After entering "start" command, message area display will indicate "START SEQUENCE INITIATED".
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SCREEN PRESENTATION SPECIFICATIONS

Menu Item:

2. The set point "S.P." shall be displayed for each equipment room thermostat. This sample screen display only shows a typical layout for a one room facility. For multiple room facilities each room shall have its own conditions displayed. The same shall apply for multiple equipment installations.

5. Temperature differential "TEMP-DIFF" is used to display the difference between the discharge and return air temperatures of the same environmental system.

6. The display for OPERATING SYSTEM shall show "HEATING", "VENTILATION", or "AIR CONDITIONING".

ddmmmyy SSP/1
hh:mm:ss

ERMS
SECURITY AND ENGINE SAFETY PARAMETERS
[XYZ] FACILITY

	PARAMETER	STATUS
1.	EQUIPMENT ROOM DOOR	[CLOSED]
2.	ENGINE ROOM DOOR	[OPEN]
3.	OTHER OPENINGS (windows etc.)	[SECURE]
4.	E/G EMERG. STOP SW. POSITION	[NML
5.	E/G ROOM FIRE DETECTOR	[NML 3
6.	EQUIP. ROOM FIRE DETECTOR	[NML
7.	E/G OVER TEMP. SAFETY	[NML 3
8.	E/G OIL PRESS. SAFETY	[NML
9.	E/G OVERCRANK SAFETY	[NML 3
10.	E/G OVERSPEED SAFETY	[LOCKED OUT]
11.	OBSTRUCTION LIGHT(S) ON/OFF	[OFF]
12.	OBSTRUCTION LIGHT(S) FAILURE	[* 1

(E)XIT TO MAIN MENU OR SPACEBAR TO UPDATE SCREEN
[XXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXX]

The security and engine safety parameter function (screen) shall provide the user with a continuously updated display. An associated help function (screen) shall be available to provide necessary instruction or explanatory notes.

SECURITY AND ENGINE SAFETY PARAMETERS

Screen Presentation Specification

Menu Item:

1&2. Door status shall be either OPEN or CLOSED. An "OPEN" door indication will generate an alarm condition unless properly by-passed.

4&5. Fire detectors will either indicate "SAFE" or "ALARM".

All other: Status shall be either **"NML"** or "LOCKED OUT". "LOCKED OUT" indication will generate an alarm condition.

ddmmmyy SSP/1
hh:mm:ss

ERMS
SECURITY AND ENGINE SAFETY PARAMETERS
[XYZ] FACILITY

	PARAMETER	STATUS
1.	EQUIPMENT ROOM DOOR	[CLOSED]
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6.	EQUIP. ROOM FIRE DETECTOR	[NML
7.	E/G OVER TEMP. SAFETY	[NML 3
8.	E/G OIL PRESS. SAFETY	[NML
9.	E/G OVERCRANK SAFETY	[NML 3
10.	E/G OVERSPEED SAFETY	[LOCKED OUT]
11.	OBSTRUCTION LIGHT(S) ON/OFF	[OFF]
12.	OBSTRUCTION LIGHT(S) FAILURE	[* 1

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[XXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXX]

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All other: Status shall be either **"NML"** or "LOCKED OUT". "LOCKED OUT" indication will generate an alarm condition.

Screen Presentation Specifications

When any alarm point is disabled, the word "DISABLED" shall appear in both the high and low alarm point column.

NOTE: Different facility types may have different alarm

1. Either commercial or E/G output voltages shall be displayed depending on which is supplying the line current.

2. If an E/G is present in the facility, the E/G group battery voltage shall be displayed. If an E/G is not present, the facility backup battery voltage shall be displayed.

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When any alarm point is disabled, the word "DISABLED" shall appear in both the high and low alarm point column.

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ddmmmyy SP/1
hh:mm:ss

ERMS
Date and **Time/SITEGEN PARAMETERS**
[XYZ] FACILITY

CURRENT DATE: [dd/mmm/yy] NEW DATE: [/ / 3
CURRENT TIME: [hh/mm/ss] NEW TIME: [/ /

OBSTRUCTION LIGHT DATA
NUMBER OF OBSTRUCTION LIGHTS: (PARALLEL) [xx]
OBSTRUCTION LIGHT CIRCUIT VOLTAGE: [xxx] VOLTS
OBSTRUCTION LIGHT CIRCUIT RESISTANCE: [xxxx] OHMS

FACILITY BACKUP OR E/G BATTERY DATA
AMPER HOUR RATING OF FAC / EG BATTERIES (TOTAL): [xxxx] AMPHRS
FACILITY EQUIPMENT amperes DRAIN: [xxxx] AMPS
NOMINAL FLOAT VOLTAGE [xxxx] VOLTS

ERMS UPS BATTERY DATA
AMPER HOUR RATING OF UPS BATTERIES (TOTAL): [xxxx] AMPHRS
ERMS EQUIPMENT amperes DRAIN: [xxxx] AMPS
NOMINAL FLOAT VOLTAGE [xxxx] VOLTS
[XXXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXXX]

ddmmmyy SP/2
hh:mm:ss

ERMS
Date and Time/SITEGEN PARAMETERS
[XYZ] FACILITY

E/G DATA

IS THERE AN E/G ON SITE? [x] (Y OR N)
FUEL TANK CAPACITY: [xxxx] GALLONS
FULL POWER FUEL CONSUMPTION [xxxx] GPH
ESTIMATED POWER FACTOR [0.xx]

[XXXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXXX]

The date and time set and SITEGEN input parameters screen shall provide the user with the capability to input facility (site) specific information that will be used by various information processing routines.

ddmmmyy SP/1
hh:mm:ss

ERMS
Date and **Time/SITEGEN PARAMETERS**
[XYZ] FACILITY

CURRENT DATE: [dd/mmm/yy] NEW DATE: [/ / 3
CURRENT TIME: [hh/mm/ss] NEW TIME: [/ /

OBSTRUCTION LIGHT DATA
NUMBER OF OBSTRUCTION LIGHTS: (PARALLEL) [xx]
OBSTRUCTION LIGHT CIRCUIT VOLTAGE: [xxx] VOLTS
OBSTRUCTION LIGHT CIRCUIT RESISTANCE: [xxxx] OHMS

FACILITY BACKUP OR E/G BATTERY DATA
AMPER HOUR RATING OF FAC / EG BATTERIES (TOTAL): [xxxx] AMPHRS
FACILITY EQUIPMENT amperes DRAIN: [xxxx] AMPS
NOMINAL FLOAT VOLTAGE [xxxx] VOLTS

ERMS UPS BATTERY DATA
AMPER HOUR RATING OF UPS BATTERIES (TOTAL): [xxxx] AMPHRS
ERMS EQUIPMENT amperes DRAIN: [xxxx] AMPS
NOMINAL FLOAT VOLTAGE [xxxx] VOLTS
[XXXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXXX]

ddmmmyy SP/2
hh:mm:ss

ERMS
Date and Time/SITEGEN PARAMETERS
[XYZ] FACILITY

E/G DATA

IS THERE AN E/G ON SITE? [x] (Y OR N)
FUEL TANK CAPACITY: [xxxx] GALLONS
FULL POWER FUEL CONSUMPTION [xxxx] GPH
ESTIMATED POWER FACTOR [0.xx]

[XXXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXXX]

The date and time set and SITEGEN input parameters screen shall provide the user with the capability to input facility (site) specific information that will be used by various information processing routines.

ddmmmyy ERMS DA/l
hh:mm:ss
Alarm and Alert DISABLE SELECTION
[XYZ] FACILITY

COML VOLTAGE	[x]	FIRE DETECTOR	[x]
E/G VOLTAGE	[x]	INTRUSION	[x]
E/G BAT VOLTAGE	[x]	E/G EMER STOP	[x]
B/U BAT VOLTAGE	[x]	E/G ROOM TEMP	[x]
COML CURRENT	[x]	UPS BAT VOLTAGE	[x]
E/G CURRENT	[x]	OVERCRANK LOCKOUT	[x]
E/G FREQ	[x]	OIL PRESS LOCKOUT	[x]
B/U BAT CURRENT	[x]	OVERSPD LOCKOUT	[x]
OIL PRESSURE	[x]	OVRTEMP LOCKOUT	[x]
COOLANT LEVEL	[x]	OBST LITE	[x]
COOLANT TEMP	[x]		
E/G AIRFLOW	[x]	DEFAULT = 1 SECOND	
VENT LOWER	[x]		
FUEL LEVEL	[x]		
E/G XFER SW	[x]		
EQPT ROOM TEMP	[x]		
SAR AIR TEMP	[x]		
OAT TEMP	[x]		
HVAC AIRFLOW	[x]		

[XXXXXXXXXXXXXXMESSAGE AREAXXXXXXXXXXXXXX]

1. The entry of the character x or X in any data field shall disable the alarm and alert message notification to the MPS and PMDT for the ESCI to which is related.

2. The deletion of the character x or X from the data shall enable alarm and alert message notification to the MPS and PMDT for the ESCI to which it is related.

Appendix III

30. TYPICAL ESCI INSTALLATION

Appendix III

30. TYPICAL ESCI INSTALLATION

Appendix III

30. TYPICAL ESCI INSTALLATION

COOLANT LEVEL SENSOR INSTALLATION (TYPICAL)

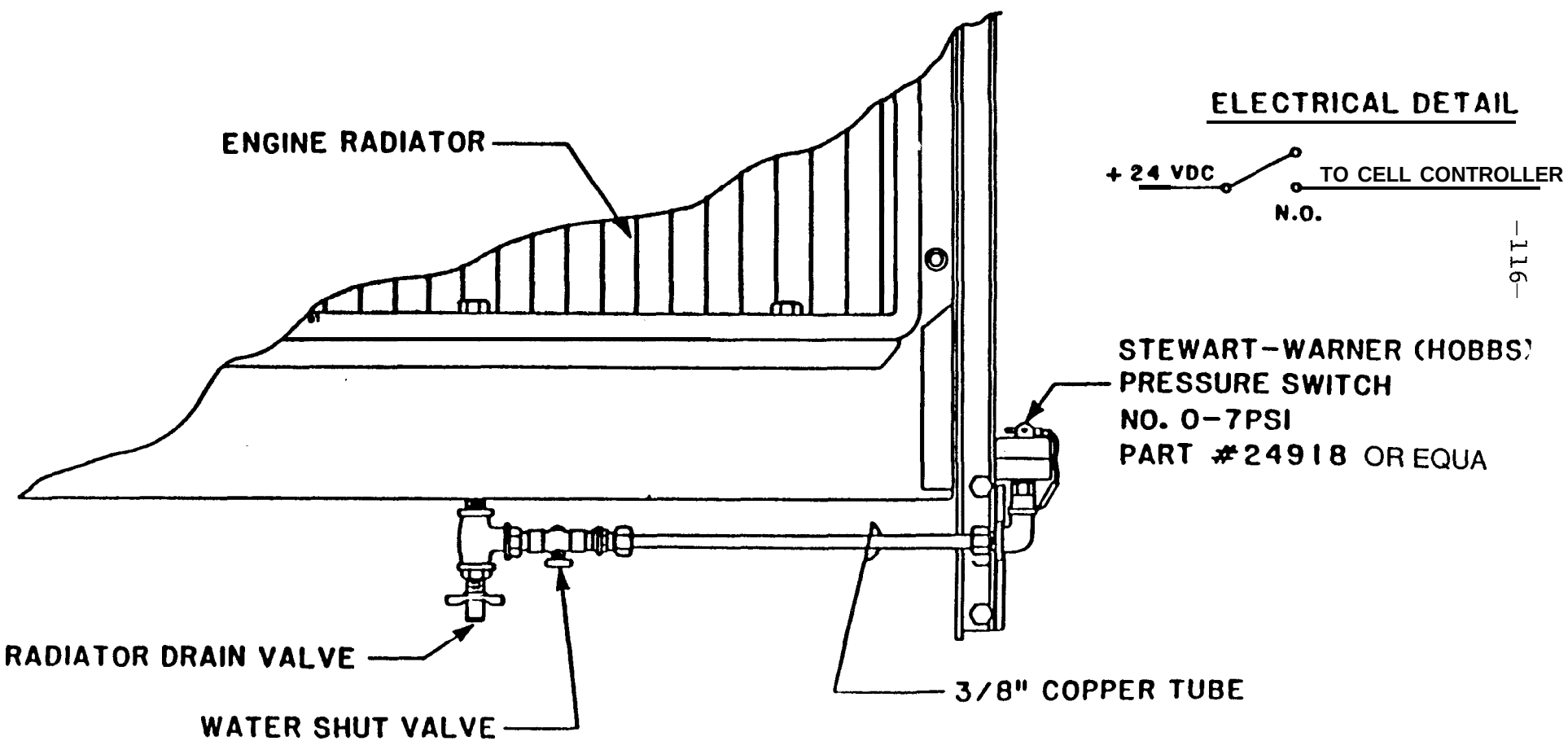


FIGURE 3
COOLANT LEVEL SENSOR INSTALLATION (TYPICAL)

COOLANT LEVEL SENSOR INSTALLATION (TYPICAL)

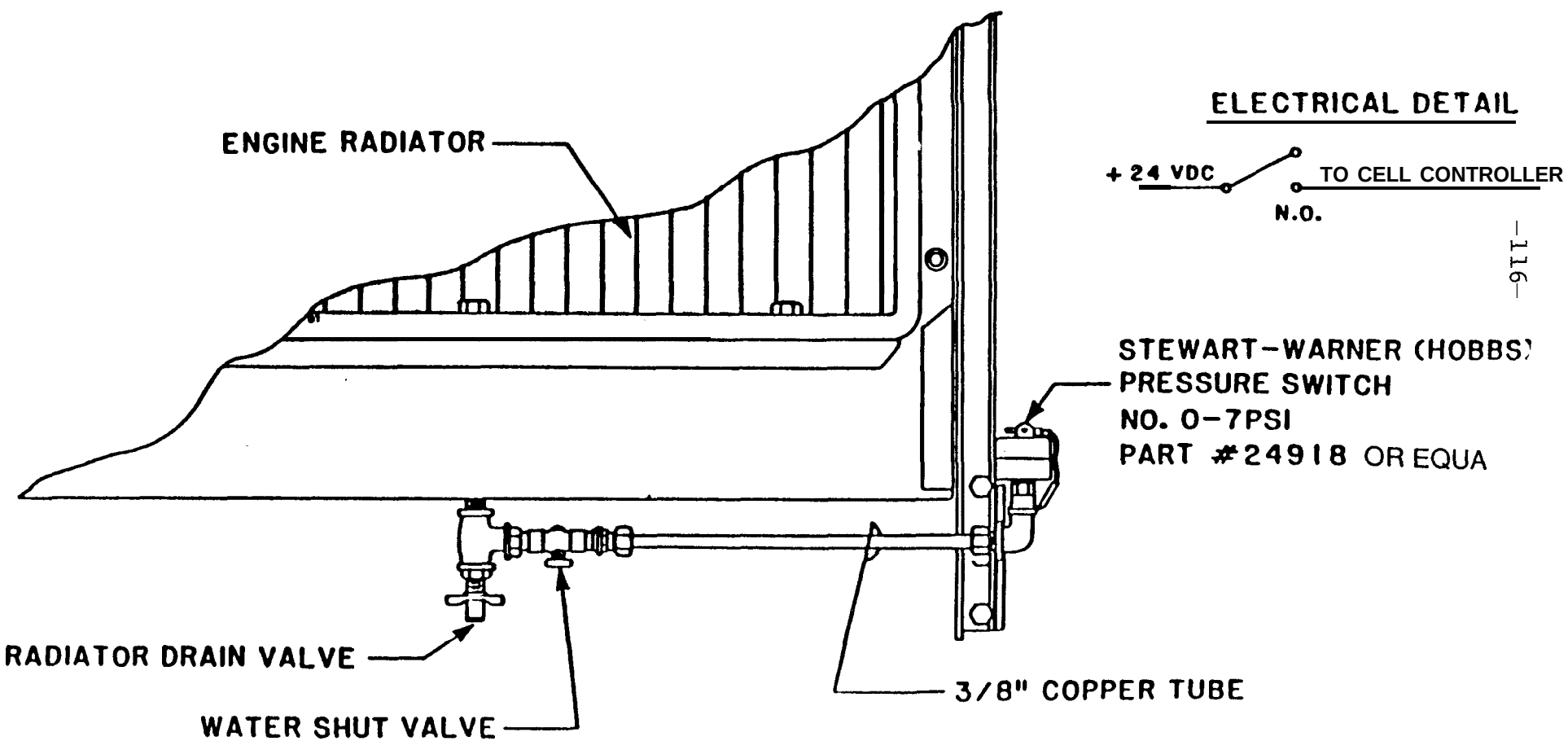


FIGURE 3
COOLANT LEVEL SENSOR INSTALLATION (TYPICAL)

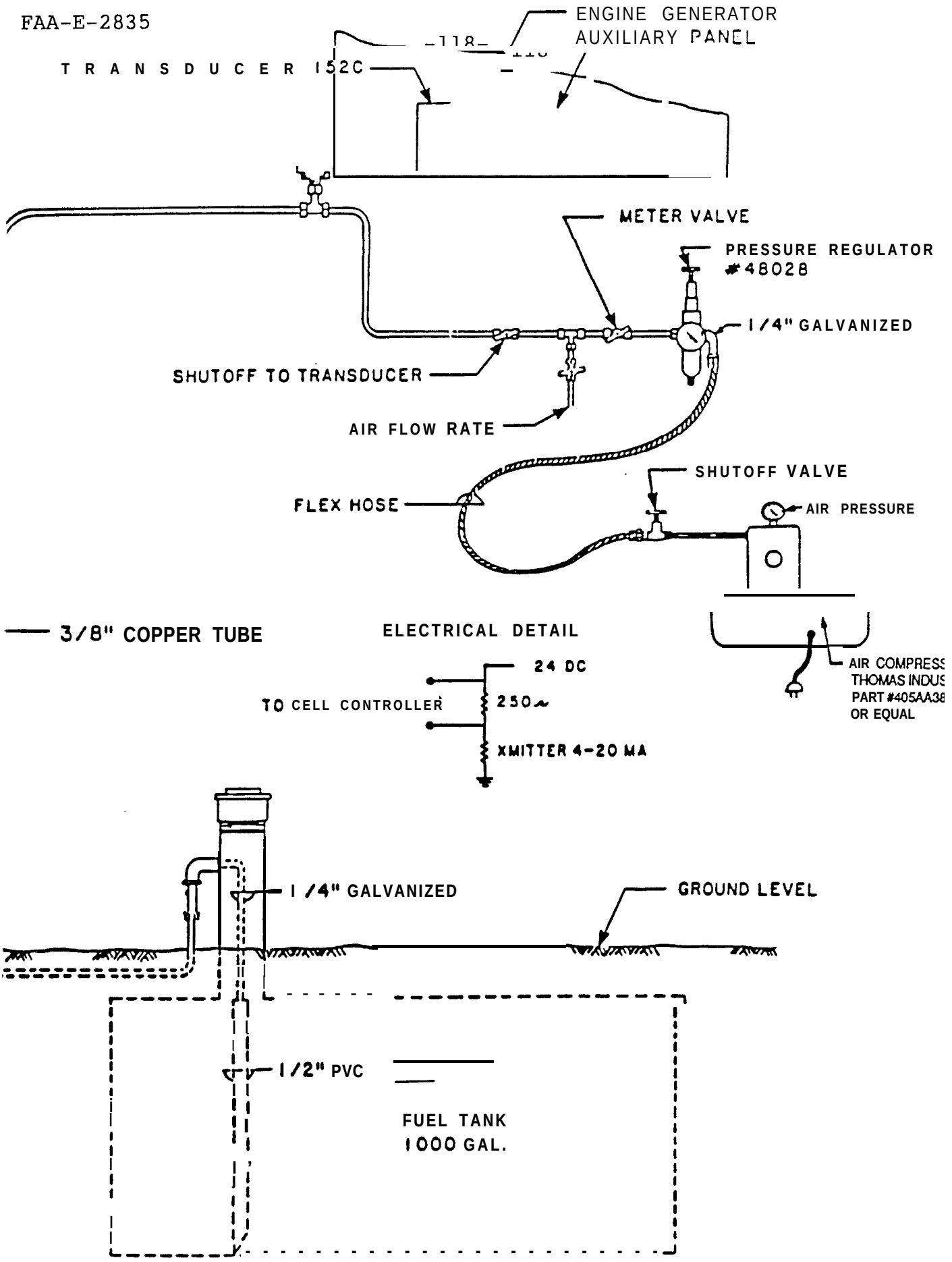


FIGURE 5
FUEL LEVEL SENSOR INSTALLATION (TYPICAL)

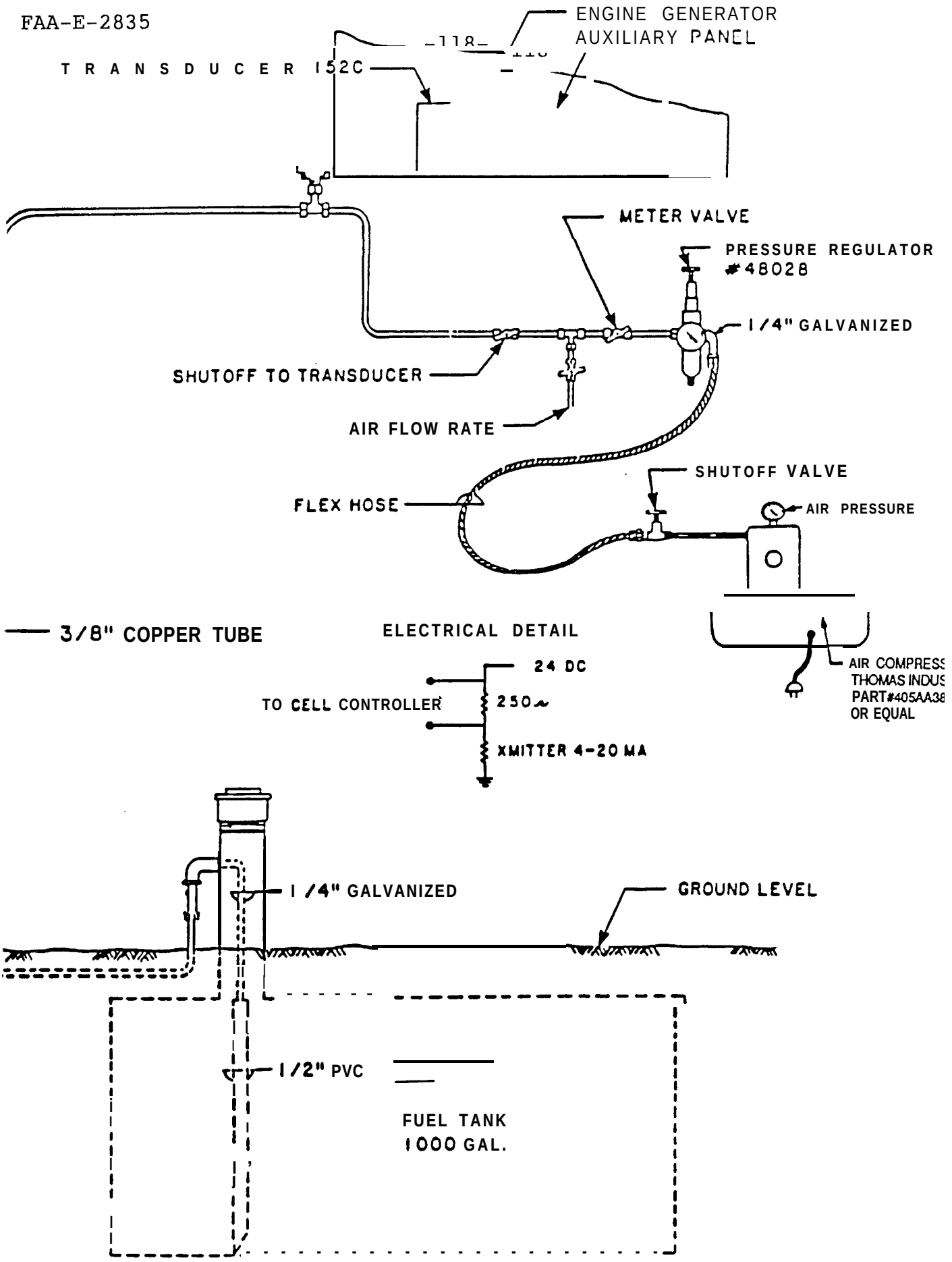


FIGURE 5

FUEL LEVEL SENSOR INSTALLATION (TYPICAL)

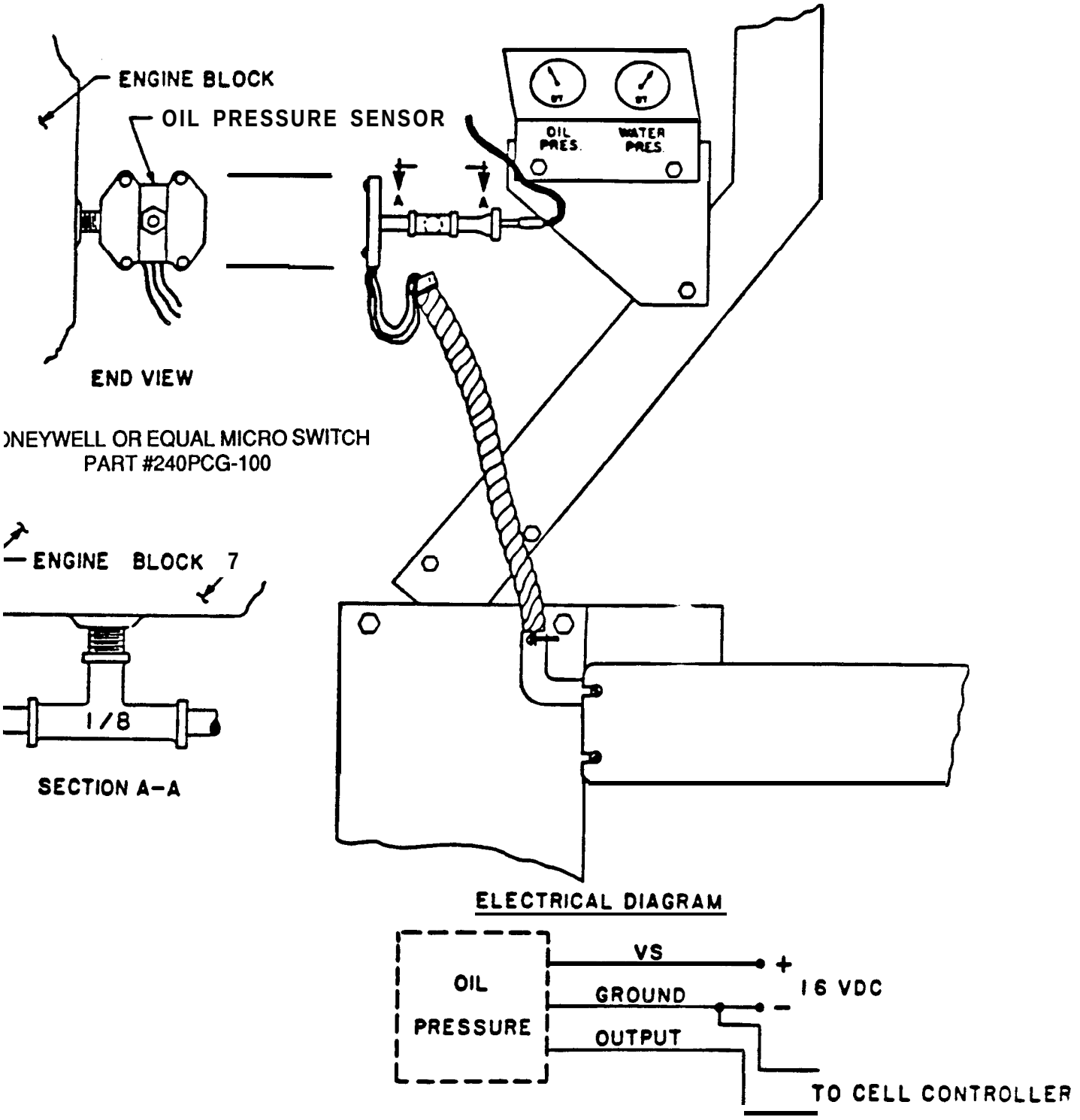


FIGURE 7

E/G OIL PRESSURE SENSOR INSTALLATION (TYPICAL)

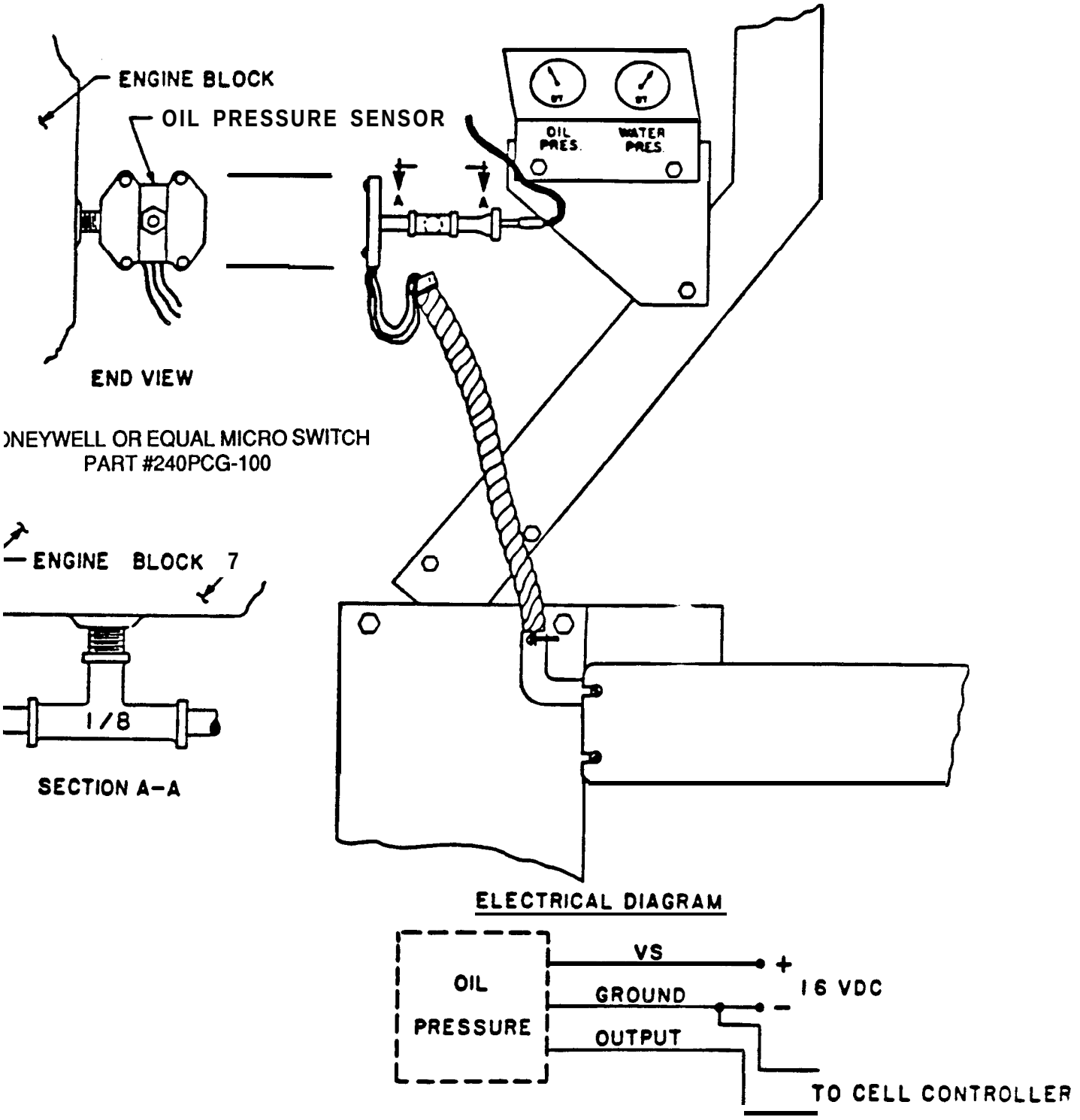
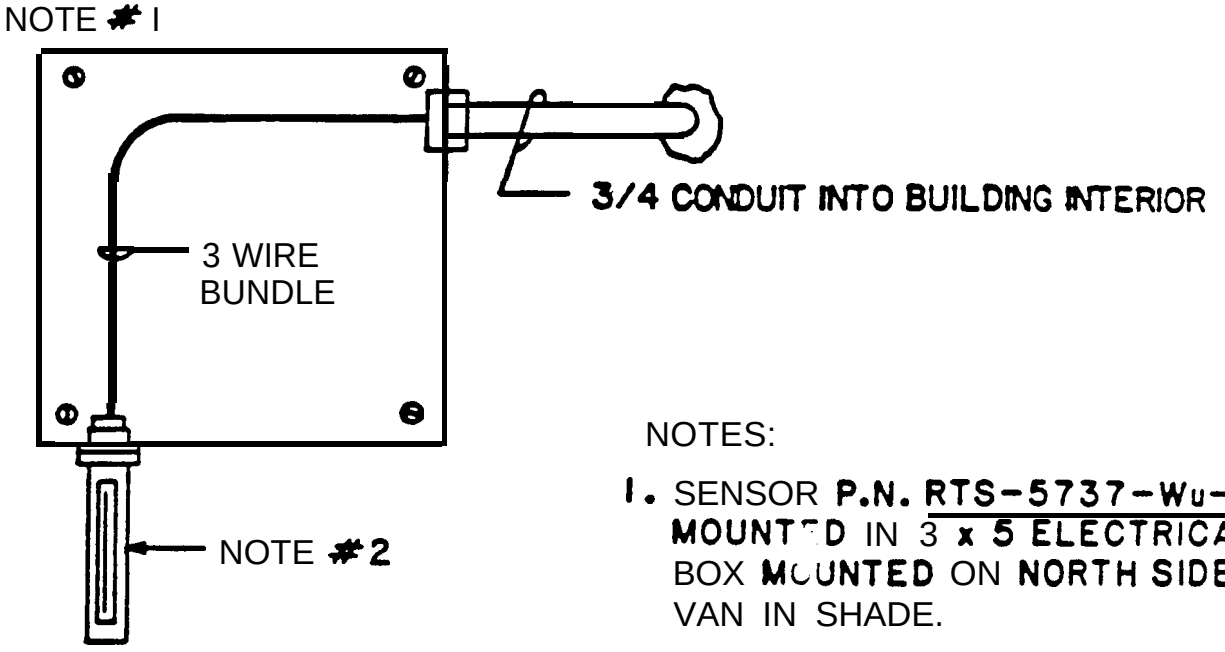


FIGURE 7

E/G OIL PRESSURE SENSOR INSTALLATION (TYPICAL)

MECHANICAL INSTALLATION



NOTES:

1. SENSOR P.N. RTS-5737-Wu-2-18 MOUNTED IN 3 x 5 ELECTRICAL BOX. BOX MOUNTED ON NORTH SIDE OF E/C VAN IN SHADE.

2. SENSOR ELEMENT MOUNTED IN PLASTIC TUBULAR HOUSING.

ELECTRICAL DIAGRAM

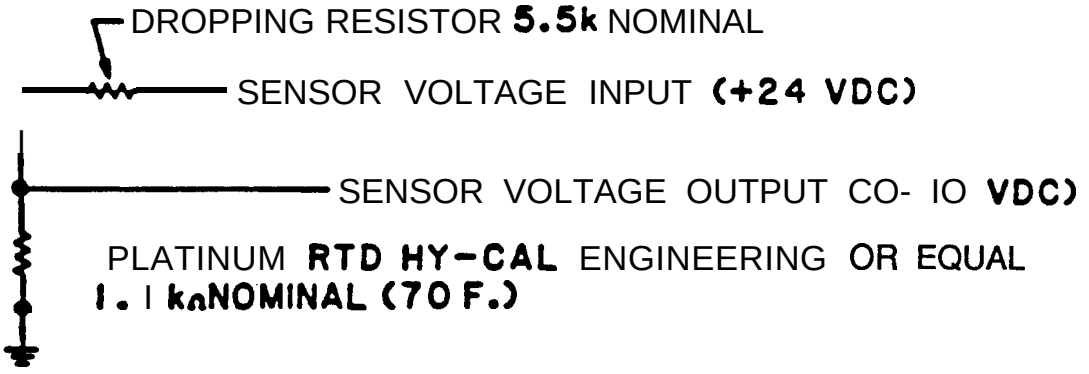
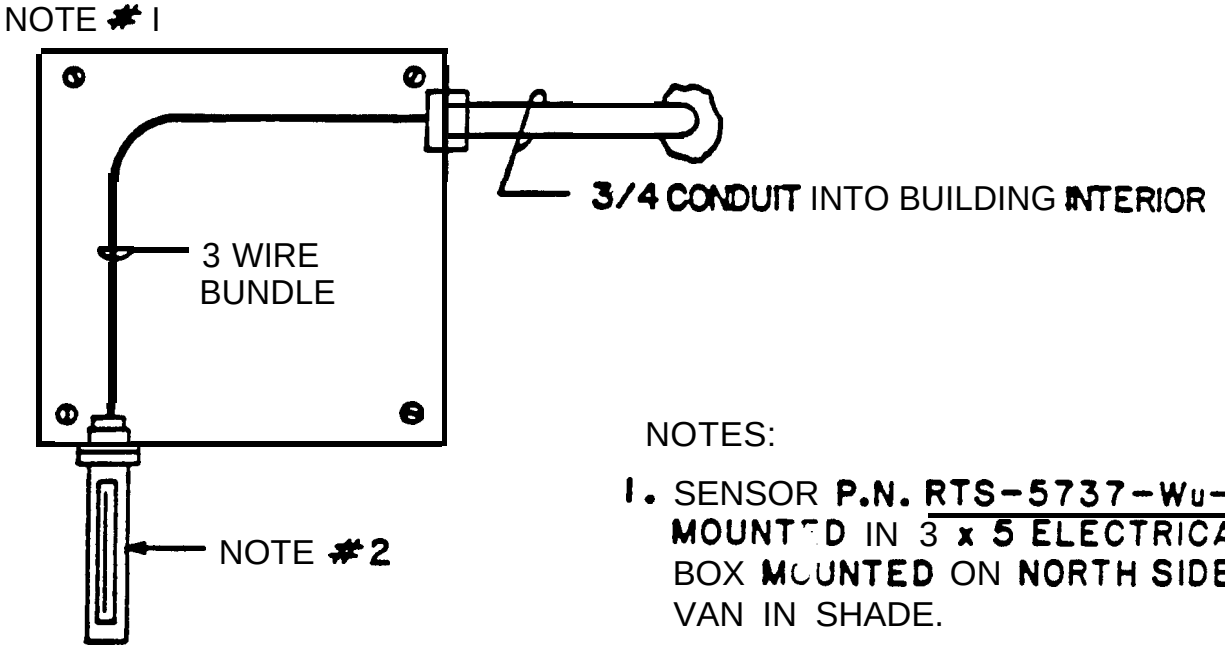


FIGURE 9

OUTSIDE AIR TEMPERATURE SENSOR INSTALLATION (TYPICAL)

MECHANICAL INSTALLATION



NOTES:

1. SENSOR P.N. RTS-5737-Wu-2-18 MOUNTED IN 3 x 5 ELECTRICAL BOX. BOX MOUNTED ON NORTH SIDE OF E/C VAN IN SHADE.

2. SENSOR ELEMENT MOUNTED IN PLASTIC TUBULAR HOUSING.

ELECTRICAL DIAGRAM

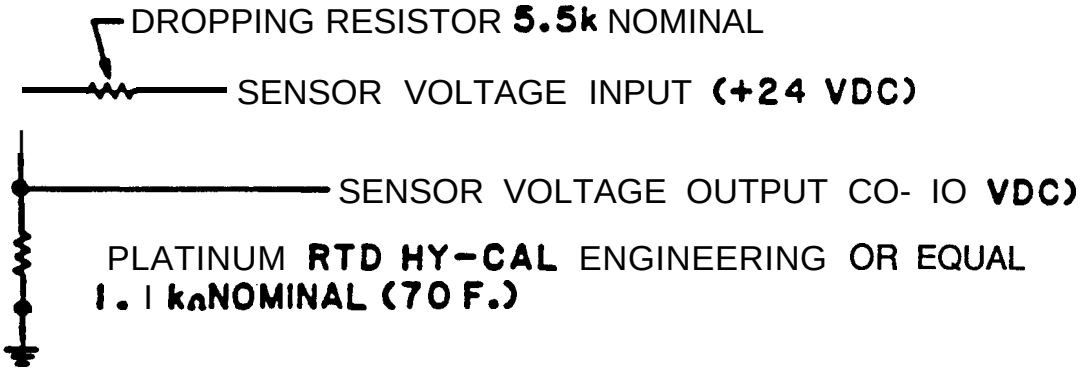


FIGURE 9
OUTSIDE AIR TEMPERATURE SENSOR INSTALLATION (TYPICAL)

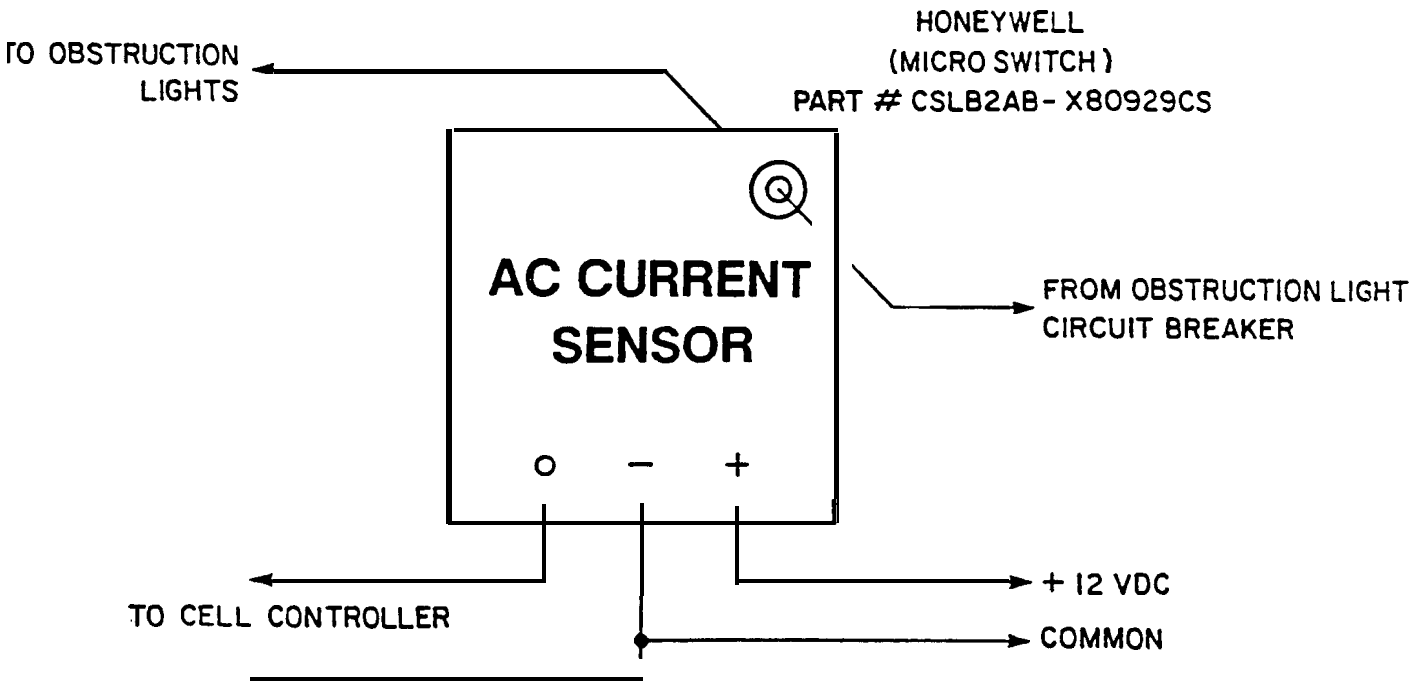


FIGURE 11

OBSTRUCTION LIGHT MONITOR SENSOR (TYPICAL)

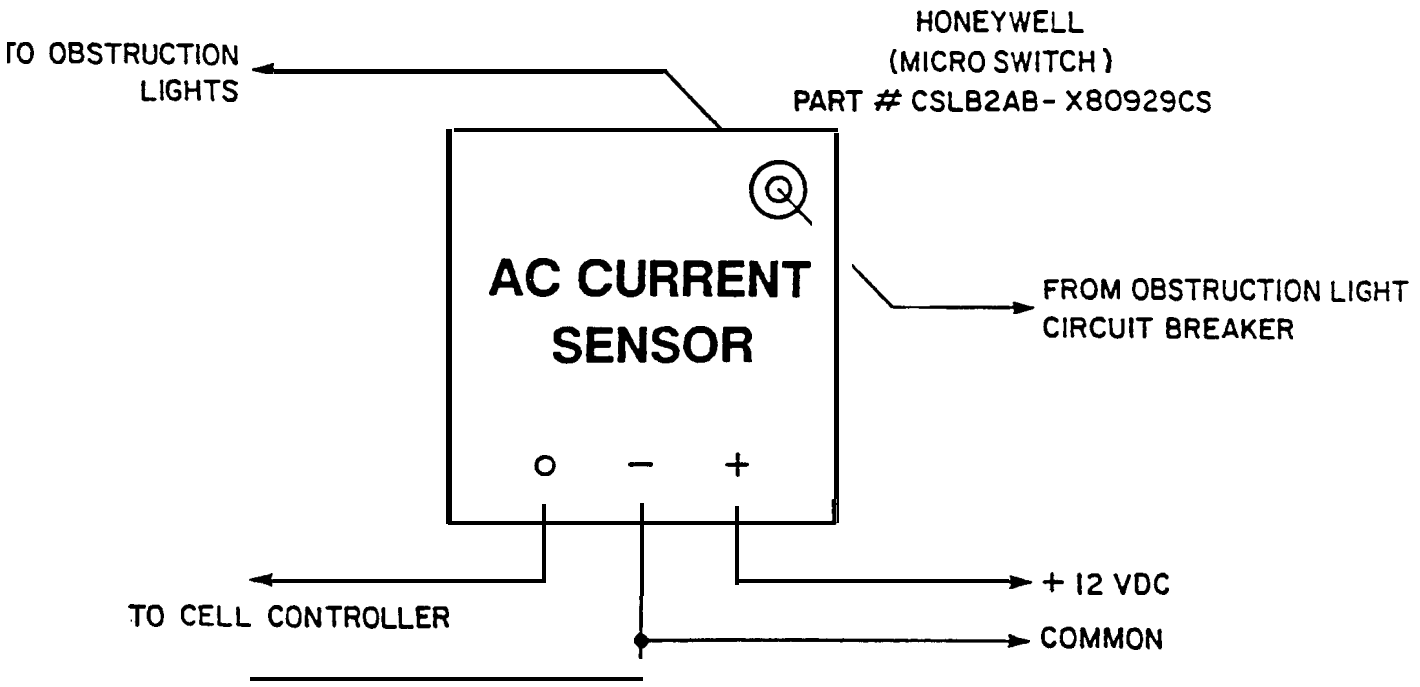


FIGURE 11

OBSTRUCTION LIGHT MONITOR SENSOR (TYPICAL)

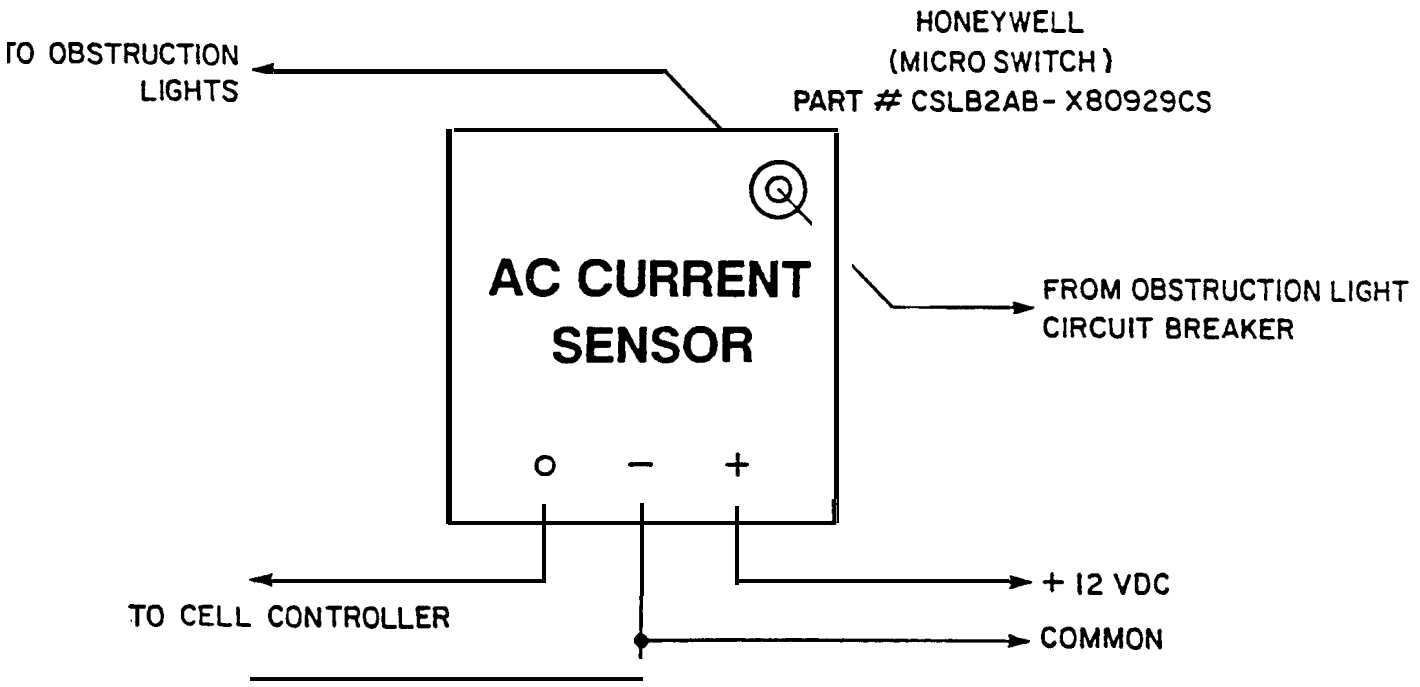


FIGURE 11

OBSTRUCTION LIGHT MONITOR SENSOR (TYPICAL)

Appendix V

50. TYPICAL ENGINE GENERATOR SENSOR CONNECTIONS

Appendix V

50. TYPICAL ENGINE GENERATOR SENSOR CONNECTIONS

Appendix VI

60. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX (VRTM)

Appendix VI

60. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX (VRTM)

APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.1.2.1.14	OPERATING STATUS CONTROL	T	D	
3.1.2.1.15	PARAMETER ADJUSTMENT	T	T	
3.1.2.1.16	RESET	T	D	
	(1)	T	D	
	(2)	T	D	
	(3)	T	D	
3.1.2.1.17	FAULT ISOLATION	D	D	
3.1.2.1.18	SPECIALIST ACCESS	D	D	
3.1.2.1.19	DATA I/O DISPLAY	D	D	
	1.	D	D	
	2.	D	D	
	3.		D	
	4.	I	D	
3.1.2.1.20	LOCAL CONTROL	T	D	
3.1.2.1.21	FACILITY SECURITY DATA	T	D	
3.1.2.1.22	RECOVERY FROM EXT PWR FAIL	D	D	
3.1.2.1.23	INPUT/OUTPUT PORTS			
	(1)	I		
	(2)	I		
3.1.2.1.24	MESSAGE TRANSFER	D	D	
3.1.3.	ERMS FUNCTIONAL RELATIONSHIPS	N/A	N/A	
3.1.4.	CONFIGURATION ALLOCATION	L	L	
3.1.4.A	A.1.[3.1.1.2(C)]	S	S	
	A.2.[3.1.1.2(B)]	S	S	
	A.3.[3.1.1.2(A)]	I		
	A.4.[3.1.1.2(E)]	D	D	
	A.5.[3.1.1.2(F)]	I		
	A.6.[3.1.1.2(G)]	T	D	
	B.1.[3.1.1.2(D)]			
	(1)	S	S	
	(2)	D	S	
	(3)	D	S	
	(4)	D	S	
	B.2.[3.1.1.2(L)]	I		
	B.3.	I	D	
	(1)	S	S	
	(2)	D	D	
	B.4.[4.1.1(F) 1] [3.1.1.2(H)]	D	D	
	(1)	S	S	
	(2)	D	D	

A = Analysis C = Contractor determines method of verification.
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NOTE: [ ]s = Prototype Vol II Ref.

APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.1.2.1.14	OPERATING STATUS CONTROL	T	D	
3.1.2.1.15	PARAMETER ADJUSTMENT	T	T	
3.1.2.1.16	RESET	T	D	
	(1)	T	D	
	(2)	T	D	
	(3)	T	D	
3.1.2.1.17	FAULT ISOLATION	D	D	
3.1.2.1.18	SPECIALIST ACCESS	D	D	
3.1.2.1.19	DATA I/O DISPLAY	D	D	
	1.	D	D	
	2.	D	D	
	3.		D	
	4.	I	D	
3.1.2.1.20	LOCAL CONTROL	T	D	
3.1.2.1.21	FACILITY SECURITY DATA	T	D	
3.1.2.1.22	RECOVERY FROM EXT PWR FAIL	D	D	
3.1.2.1.23	INPUT/OUTPUT PORTS			
	(1)	I		
	(2)	I		
3.1.2.1.24	MESSAGE TRANSFER	D	D	
3.1.3.	ERMS FUNCTIONAL RELATIONSHIPS	N/A	N/A	
3.1.4.	CONFIGURATION ALLOCATION	L	L	
3.1.4.A	A.1.[3.1.1.2(C)]	S	S	
	A.2.[3.1.1.2(B)]	S	S	
	A.3.[3.1.1.2(A)]	I		
	A.4.[3.1.1.2(E)]	D	D	
	A.5.[3.1.1.2(F)]	I		
	A.6.[3.1.1.2(G)]	T	D	
	B.1.[3.1.1.2(D)]			
	(1)	S	S	
	(2)	D	S	
	(3)	D	S	
	(4)	D	S	
	B.2.[3.1.1.2(L)]	I		
	B.3.	I	D	
	(1)	S	S	
	(2)	D	D	
	B.4.[4.1.1(F) 1] [3.1.1.2(H)]	D	D	
	(1)	S	S	
	(2)	D	D	

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APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.1.4.2.2	DATA I/O MGMT. [4.1.3]			
	(1)	C	C	
	(2)	C	C	
3.1.4.2.3	DATA COMMUNICATION / MULTI-TASKING [4.1.4]			
	(1)	C	C	
	(2)	C	C	
3.1.4.2.4	APPLICATION SOFTWARE OPERATIONS [4.2.1]	C	C	
3.1.4.2.5	SENSOR SCALING AND OFFSTTING [4.3]			
	(1)	C	C	
	(2)	C	C	
	(3)	C	C	
	(4)	C	C	
3.1.4.2.6	SYSTEM SECURITY [4.4]			
	(1)	C	C	
	(2)	C	C	
	(3)	C	C	
	(4)	C	C	
	(5)	C	C	
	(6)	C	C	
	(7)	C	C	
	(8)	C	C	
	(9)	C	C	
	(10)	C	C	
	(11)	C	C	
	(12)	C	C	
	(13)	C	C	
	(14)	C	C	
	(15)	C	C	
3.1.4.2.7	SOFTWARE PROGRAMMING LANGUAGES [3.1.1.2(L)] [3.1.1.2(M)]	C	C	
3.1.4.3	SENSOR/CONTROLLER CONFIG-URATION ITEMS [5]	C	C	
3.1.5	PERFORMANCE REQUIREMENTS			
	(1)	T		
	(2)	T		
	(3)	T	T	
	(4)	T	T	
	(5)	T	T	
	(6)	T	T	
	(7)	T	T	
	(8)	T	T	
	(9)	T	T	
3.1.5.1	MONITOR COML PWR SYSTEM[5.2]			
	(1)	D	D	
	(2)	D	D	

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APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.1.4.2.2	DATA I/O MGMT. [4.1.3]			
	(1)	C	C	
	(2)	C	C	
3.1.4.2.3	DATA COMMUNICATION / MULTI-TASKING [4.1.4]			
	(1)	C	C	
	(2)	C	C	
3.1.4.2.4	APPLICATION SOFTWARE OPERATIONS [4.2.1]	C	C	
3.1.4.2.5	SENSOR SCALING AND OFFSTTING [4.3]			
	(1)	C	C	
	(2)	C	C	
	(3)	C	C	
	(4)	C	C	
3.1.4.2.6	SYSTEM SECURITY [4.4]			
	(1)	C	C	
	(2)	C	C	
	(3)	C	C	
	(4)	C	C	
	(5)	C	C	
	(6)	C	C	
	(7)	C	C	
	(8)	C	C	
	(9)	C	C	
	(10)	C	C	
	(11)	C	C	
	(12)	C	C	
	(13)	C	C	
	(14)	C	C	
	(15)	C	C	
3.1.4.2.7	SOFTWARE PROGRAMMING LANGUAGES [3.1.1.2(L)] [3.1.1.2(M)]	C	C	
3.1.4.3	SENSOR/CONTROLLER CONFIG-URATION ITEMS [5]	C	C	
3.1.5	PERFORMANCE REQUIREMENTS			
	(1)	T		
	(2)	T		
	(3)	T	T	
	(4)	T	T	
	(5)	T	T	
	(6)	T	T	
	(7)	T	T	
	(8)	T	T	
	(9)	T	T	
3.1.5.1	MONITOR COML PWR SYSTEM[5.2]			
	(1)	D	D	
	(2)	D	D	

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APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	[5.21.1]			
3.1.5.2.8	MON. E/G & E/R FAN LOUVERS[5.7]			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	T	T	
	(5)	T	T	
3.1.5.2.9	MONITOR FUEL LEVEL [5.8]			
	(1)	D	D	
	(2)	D	D	
	(3)	T	D	
	(4)	T	T	
	(5)	T	D	
	(6)	T	D	
	(7)	T	T	
	(8)	N/A	N/A	
	(9)	N/A	N/A	
	(10)	T	T	
3.1.5.2.10	MON. BAT TERM CRNK VOLT[5.9]			
	(1)	N/A	N/A	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	A	D	
	(6)	D	D	
	(7)	D	D	
	(8)	D	D	
3.1.5.2.11	MON. E/G CRNK TIME [5.21.1]			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	D	D	
	(6)	T	D	
	(7)	D	D	
	(8)	T	D	
	(9)	D	D	
	(10)	D	D	
	(12)	D	D	
	(13)	D	D	
3.1.5.2.12	MON. XFER. SW. POS. [5.10]			
	(1)	T	D	
	(2)	T	D	
	(3)	T	D	
	(4)	T	D	
	(5)	T	D	
3.1.5.2.13	MON. E/G OIL PRESSURE [5.11]			
	(1)	N/A	N/A	
	(2)	I	I	
	(3)	I	I	
	(4)	S	S	
3.1.5.2.14	MON. E/G PH OTPT VOLT [5.2]			
	(1)	I	I	
	(2)	I	I	
	(3)	D	D	
	(4)	D	D	

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S = Redundant requirement T = Test I = Inspection
NOTE: [ ]s = Prototype Vol II Ref.

APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	[5.21.1]			
3.1.5.2.8	MON. E/G & E/R FAN LOUVERS[5.7]			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	T	T	
	(5)	T	T	
3.1.5.2.9	MONITOR FUEL LEVEL [5.8]			
	(1)	D	D	
	(2)	D	D	
	(3)	T	D	
	(4)	T	T	
	(5)	T	D	
	(6)	T	D	
	(7)	T	T	
	(8)	N/A	N/A	
	(9)	N/A	N/A	
	(10)	T	T	
3.1.5.2.10	MON. BAT TERM CRNK VOLT[5.9]			
	(1)	N/A	N/A	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	A	D	
	(6)	D	D	
	(7)	D	D	
	(8)	D	D	
3.1.5.2.11	MON. E/G CRNK TIME [5.21.1]			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	D	D	
	(6)	T	D	
	(7)	D	D	
	(8)	T	D	
	(9)	D	D	
	(10)	D	D	
	(12)	D	D	
	(13)	D	D	
3.1.5.2.12	MON. XFER. SW. POS. [5.10]			
	(1)	T	D	
	(2)	T	D	
	(3)	T	D	
	(4)	T	D	
	(5)	T	D	
3.1.5.2.13	MON. E/G OIL PRESSURE [5.11]			
	(1)	N/A	N/A	
	(2)	I	I	
	(3)	I	I	
	(4)	S	S	
3.1.5.2.14	MON. E/G PH OTPT VOLT [5.2]			
	(1)	I	I	
	(2)	I	I	
	(3)	D	D	
	(4)	D	D	

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ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.1.5.3.2	MON BAT SYS EQUALIZING VOLT			
	(1)	D	D	
	(2)	T	T	
	(3)	T	T	
3.1.5.3.3	MON BAT SYS OUTPUT VOLT			
	(1)	D	D	
	(2)	D	D	
3.1.5.4.1	MON ROOM TEMPS [5.14]			
	(1)	D	D	
	(2)	D	D	
	(3)	T	T	
	(4)	D	D	
	(5)	D	D	
3.1.5.4.2	MON SUPLY/RET AIR TMP [5.15]	I	I	
3.1.5.4.3	MON OAT [5.16]			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
	(5)	I	I	
	(6)	I	I	
	(7)	I	I	
3.1.5.4.4	MON. HVAC AIR FLOWS [5.17]			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
	(5)	I	I	
3.1.5.5	MON. SYSTEM SECURITY [4.4]	D	D	
3.1.5.5.1	MON. FIRE/SMOKE DET [5.18]			
	(1)	I	I	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
3.1.5.5.2	MON. INTRUSN ALARMS [5.19]			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	D	D	
3.1.5.5.3	MON. OBS LITE OPN [2.1.1]			
	(1)	D	D	
	(2)	D	D	
3.1.5.6	PROVIDE EQPT START/STOP			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	D	D	
	(6)	D	D	

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APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.1.5.3.2	MON BAT SYS EQUALIZING VOLT			
	(1)	D	D	
	(2)	T	T	
	(3)	T	T	
3.1.5.3.3	MON BAT SYS OUTPUT VOLT			
	(1)	D	D	
	(2)	D	D	
3.1.5.4.1	MON ROOM TEMPS [5.14]			
	(1)	D	D	
	(2)	D	D	
	(3)	T	T	
	(4)	D	D	
	(5)	D	D	
3.1.5.4.2	MON SUPLY/RET AIR TMP [5.15]	I	I	
3.1.5.4.3	MON OAT [5.16]			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
	(5)	I	I	
	(6)	I	I	
	(7)	I	I	
3.1.5.4.4	MON. HVAC AIR FLOWS [5.17]			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
	(5)	I	I	
3.1.5.5	MON. SYSTEM SECURITY [4.4]	D	D	
3.1.5.5.1	MON. FIRE/SMOKE DET [5.18]			
	(1)	I	I	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
3.1.5.5.2	MON. INTRUSN ALARMS [5.19]			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	D	D	
3.1.5.5.3	MON. OBS LITE OPN [2.1.1]			
	(1)	D	D	
	(2)	D	D	
3.1.5.6	PROVIDE EQPT START/STOP			
	(1)	D	D	
	(2)	D	D	
	(3)	D	D	
	(4)	D	D	
	(5)	D	D	
	(6)	D	D	

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	004	I	I	
3.1.6.1.3	HARDWARE-TO-HARDWARE EXT INTERFACES [4.1.4E]			
	A. EIIN001			
	(1)	D	D	
	(2)	I		
	B. EIIN002			
	(1)	D		
	(2)	I		
3.1.6.1.4		N/A	N/A	
3.1.6.1.5	SOFTWARE-TO-SOFTWARE EXT INTERFACES [4.1.4E]			
	A. EIIN003			
	(1)	L	L	
	(2)		D	
	(3)		D	
	(4)1.		D	
	2.		D	
	3.		D	
	4.		D	
	(5)1.		D	
	2.		D	
	3.			
	B. EIIN004			
	(1)	L	L	
	(2)	L	L	
3.1.6.2	INTERNAL INTERFACES	N/A	N/A	
3.1.6.2.1	INTERNAL INTERFACE IDENT	I		
3.1.6.2.2	HWCI-TO-HWCI INTERFACES	I		
3.1.6.2.3	HWCI-TO-CSCI INTERFACES	I		
3.1.6.2.4	CSCI-TO-CSCI INTERFACES	I		
3.1.7	GOVT FURNISHED RESOURCES	N/A	N/A	
3.2	SYSTEM CHARACTERISTICS	N/A	N/A	
3.2.1	HARDWARE CHARACTERISTICS [4.1C]	L	L	
3.2.1.1	MANUFACTURE [4.1.(A)]			
	(1)	I	I	
	(2)	S	I	
3.2.1.2	COMPONENT CONST [4.1.(B)]			
	(1)	I	I	
	(2)	S	I	
3.2.1.3	MODULARITY [4.1.(C)]	I		
	(1)	I	I	
	(2)	I	I	
3.2.1.4	COMPONENT MARKING[4.1(D)]	I		
3.2.1.5	COMPONENT INTERCHANGABILITY [4.1(D)]			

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	004	I	I	
3.1.6.1.3	HARDWARE-TO-HARDWARE EXT INTERFACES [4.1.4E]			
	A. EIIN001			
	(1)	D	D	
	(2)	I		
	B. EIIN002			
	(1)	D		
	(2)	I		
3.1.6.1.4		N/A	N/A	
3.1.6.1.5	SOFTWARE-TO-SOFTWARE EXT INTERFACES [4.1.4E]			
	A. EIIN003			
	(1)	L	L	
	(2)		D	
	(3)		D	
	(4)1.		D	
	2.		D	
	3.		D	
	4.		D	
	(5)1.		D	
	2.		D	
	3.			
	B. EIIN004			
	(1)	L	L	
	(2)	L	L	
3.1.6.2	INTERNAL INTERFACES	N/A	N/A	
3.1.6.2.1	INTERNAL INTERFACE IDENT	I		
3.1.6.2.2	HWCI-TO-HWCI INTERFACES	I		
3.1.6.2.3	HWCI-TO-CSCI INTERFACES	I		
3.1.6.2.4	CSCI-TO-CSCI INTERFACES	I		
3.1.7	GOVT FURNISHED RESOURCES	N/A	N/A	
3.2	SYSTEM CHARACTERISTICS	N/A	N/A	
3.2.1	HARDWARE CHARACTERISTICS [4.1C]	L	L	
3.2.1.1	MANUFACTURE [4.1.(A)]			
	(1)	I	I	
	(2)	S	I	
3.2.1.2	COMPONENT CONST [4.1.(B)]			
	(1)	I	I	
	(2)	S	I	
3.2.1.3	MODULARITY [4.1.(C)]	I		
	(1)	I	I	
	(2)	I	I	
3.2.1.4	COMPONENT MARKING[4.1(D)]	I		
3.2.1.5	COMPONENT INTERCHANGABILITY [4.1(D)]			

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.2.1.10	CPU(S)/DATA STORAGE [4.1.1]			
	(1)	I		
	(2)	I		
	A.(1)	I		
	(2)	I		
	(3)	I		
	(4)	I		
	(5)	I		
	A.1.(1)	I		
	(2)	I		
	A.2.	I		
	A.3.(1)	I		
	(2)	I		
	(3)	I		
	(4)	I		
	B.	I		
3.2.1.11	I/O DEVICES[3.1.1.2(E)] [4.1.2]			
	(1)	I		
	(2)	I		
	(3)	I		
	(4)	I		
	(5)	I		
	A.(1)	I		
	(2)	I		
	B.	I		
	B.1.(1)	I		
	(2)	I		
	B.2.(1)	I		
	(2)	I		
	B.3.	I		
	B.4.(1)	I		
	(2)	I		
	(3)	I		
	B.5.	I		
	C.	I		
	C.1.	I		
	C.2.	I		
	C.3.	I		
	C.4.	I		
	C.5.	I		
	C.6.	I		
	D.	I		
	D.1.(1)	I		
	(2)	I		
	D.2.	I		
	D.3.	I		
	E.(1)	I		
	(2)	I		
	F.	I		
	F.1	I		
	F.2	I		
	(1)	I		
	(2)	I		
	F.3	I		
	F.4	I		
	F.5	I		
	(1)	I		
	(2)	I		
	(3)	I		
	F.6	I		
3.2.2	GEN. CELL CONTROLLER OP. CHAR.	N/A	N/A	

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.2.1.10	CPU(S)/DATA STORAGE [4.1.1]			
	(1)	I		
	(2)	I		
	A.(1)	I		
	(2)	I		
	(3)	I		
	(4)	I		
	(5)	I		
	A.1.(1)	I		
	(2)	I		
	A.2.	I		
	A.3.(1)	I		
	(2)	I		
	(3)	I		
	(4)	I		
	B.	I		
3.2.1.11	I/O DEVICES[3.1.1.2(E)] [4.1.2]			
	(1)	I		
	(2)	I		
	(3)	I		
	(4)	I		
	(5)	I		
	A.(1)	I		
	(2)	I		
	B.	I		
	B.1.(1)	I		
	(2)	I		
	B.2.(1)	I		
	(2)	I		
	B.3.	I		
	B.4.(1)	I		
	(2)	I		
	(3)	I		
	B.5.	I		
	C.	I		
	C.1.	I		
	C.2.	I		
	C.3.	I		
	C.4.	I		
	C.5.	I		
	C.6.	I		
	D.	I		
	D.1.(1)	I		
	(2)	I		
	D.2.	I		
	D.3.	I		
	E.(1)	I		
	(2)	I		
	F.	I		
	F.1	I		
	F.2	I		
	(1)	I		
	(2)	I		
	F.3	I		
	F.4	I		
	F.5	I		
	(1)	I		
	(2)	I		
	(3)	I		
	F.6	I		
3.2.2	GEN. CELL CONTROLLER OP. CHAR.	N/A	N/A	

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.2.2.2	GENERAL PROGRAM MEMORY CHAR. [4.1.1]			
	A.(1)			
	(2)		I	
	B.(1)		I	
	(2)		I	
	(3)		I	
	(4)			
	C.		I	
3.2.2.3	GEN. DATA I/O MGMT. CHAR. [4.1.3]			
	A.(1)		I	
	(2)		I	
	(3)		I	
	(4)			
	(5)		I	
	B.(1)		I	
	(2)		I	
	(3)		I	
	C.(1)			
	(2)		I	
	(3)			
	(4)		I	
3.2.2.4	GENERAL COMM. AND MULTI-TASKING CHARS. {4.1.4]			
	(1)		I	
	(2)		I	
	A.(1)		I	
	(2)		I	
	B.(1)		I	
	(2)		I	
	(3)		I	
	C.		I	
	C.1.(1)		I	
	(2)		I	
	(3)		I	
	C.2.(1)		I	
	(2)		I	
	C.3.(1)		I	
	(2)		I	
	C.4.(1)		I	
	(2)		I	
	C.5		I	
	D.		I	
	E.(1)		I	
	(2)		I	
	(3)		I	
	F.(1)		I	
	(2)		I	
3.2.2.5	GENERAL APPLICATION SOFTWARE CHARACTERISTICS [4.2.1]			
	(1)			
	(2)		I	
	(3)			
	(4)		I	
	A.		I	
	B.		I	
	C.		I	
	1.		I	
	(1)		I	
	(2)		I	

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
3.2.2.2	GENERAL PROGRAM MEMORY CHAR. [4.1.1]			
	A.(1)			
	(2)		I	
	B.(1)		I	
	(2)		I	
	(3)		I	
	(4)			
	C.		I	
3.2.2.3	GEN. DATA I/O MGMT. CHAR. [4.1.3]			
	A.(1)		I	
	(2)		I	
	(3)		I	
	(4)			
	(5)		I	
	B.(1)		I	
	(2)		I	
	(3)		I	
	C.(1)			
	(2)		I	
	(3)			
	(4)		I	
3.2.2.4	GENERAL COMM. AND MULTI-TASKING CHARS. {4.1.4]			
	(1)		I	
	(2)		I	
	A.(1)		I	
	(2)		I	
	B.(1)		I	
	(2)		I	
	(3)		I	
	C.		I	
	C.1.(1)		I	
	(2)		I	
	(3)		I	
	C.2.(1)		I	
	(2)		I	
	C.3.(1)		I	
	(2)		I	
	C.4.(1)		I	
	(2)		I	
	C.5		I	
	D.		I	
	E.(1)		I	
	(2)		I	
	(3)		I	
	F.(1)		I	
	(2)		I	
3.2.2.5	GENERAL APPLICATION SOFTWARE CHARACTERISTICS [4.2.1]			
	(1)			
	(2)		I	
	(3)			
	(4)		I	
	A.		I	
	B.		I	
	C.		I	
	1.		I	
	(1)		I	
	(2)		I	

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	F.	I		
	G.	I		
	H.(1)	I		
	(2)	I		
	I.(1)	I		
	(2)	I		
	J.(1)	I		
	(2)	I		
	K.1.	I		
	K.2.	I		
	K.3.	I		
	K.4.	I		
3.2.3	ERMS SENSOR CONFIGURATION ITEM CHARACTERISTICS (ESCI)			
	[5.01	I		
	A.1.	I		
	A.2.(1)	I		
	(2)	I		
	A.3.	I		
	B.	I		
3.2.3.1	COML. E/G VOLT. ESCI [5.2]			
	A.(1)	I		
	(2)	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
3.2.3.2	COML. E/G PH CURNT ESCI[5.3]	I		
	A.(1)	I		
	(2)	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
3.2.3.3	OIL LEVEL ESCI [5.4]	I		
	A.	I		
	B.	I		
	C.	I		
	D.(1)	I		
	(2)	I		
	E.(1)	I		
	(2)	I		
	F.	I		
	G.	I		
	H.	I		
3.2.3.4	E/G COOLANT LEVEL ESCI[5.5]	I		
	A.(1)	I		
	(2)	I		
	B.(1)	I		
	(2)	I		
	(3)	I		
	c.(1)	I		
	(2)	I		
	D.	I		
	E.	I		
	(1)	I		
	(2)	I		

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	F.	I		
	G.	I		
	H.(1)	I		
	(2)	I		
	I.(1)	I		
	(2)	I		
	J.(1)	I		
	(2)	I		
	K.1.	I		
	K.2.	I		
	K.3.	I		
	K.4.	I		
3.2.3	ERMS SENSOR CONFIGURATION ITEM CHARACTERISTICS (ESCI)			
	[5.01	I		
	A.1.	I		
	A.2.(1)	I		
	(2)	I		
	A.3.	I		
	B.	I		
3.2.3.1	COML. E/G VOLT. ESCI [5.2]			
	A.(1)	I		
	(2)	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
3.2.3.2	COML. E/G PH CURNT ESCI[5.3]	I		
	A.(1)	I		
	(2)	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
3.2.3.3	OIL LEVEL ESCI [5.4]	I		
	A.	I		
	B.	I		
	C.	I		
	D.(1)	I		
	(2)	I		
	E.(1)	I		
	(2)	I		
	F.	I		
	G.	I		
	H.	I		
3.2.3.4	E/G COOLANT LEVEL ESCI[5.5]	I		
	A.(1)	I		
	(2)	I		
	B.(1)	I		
	(2)	I		
	(3)	I		
	c.(1)	I		
	(2)	I		
	D.	I		
	E.	I		
	(1)	I		
	(2)	I		

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	(5)	I		
	F.	I		
	G.	I		
	H.	I		
	I	I		
	J.(1)	I		
	(2)	I		
3.2.3.8	E/G BATT. VOLTAGE ESCI. [5.9			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B.	I		
	C.	I		
	D.(1)	I		
	(2)	I		
	E.	I		
3.2.3.9	E/G XFER SW POS ESCI. [5.10]			
	(1)	I		
	(2)	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.(1)	I		
	(2)	I		
3.2.3.10	E/G OIL PRESSURE ESCI.[5.11]			
	(1)	I		
	(2)	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.2.3.11	E/G FREQUENCY ESCI.[5.12]			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B.(1)	I		
	(2)	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
	J.	I		
3.2.3.12	E/G COOLANT TEMP ESCI.[5.13]			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B:(l)	I		

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	(5)	I		
	F.	I		
	G.	I		
	H.	I		
	I	I		
	J.(1)	I		
	(2)	I		
3.2.3.8	E/G BATT. VOLTAGE ESCI. [5.9			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B.	I		
	C.	I		
	D.(1)	I		
	(2)	I		
	E.	I		
3.2.3.9	E/G XFER SW POS ESCI. [5.10]			
	(1)	I		
	(2)	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.(1)	I		
	(2)	I		
3.2.3.10	E/G OIL PRESSURE ESCI.[5.11]			
	(1)	I		
	(2)	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.2.3.11	E/G FREQUENCY ESCI.[5.12]			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B.(1)	I		
	(2)	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
	J.	I		
3.2.3.12	E/G COOLANT TEMP ESCI.[5.13]			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B:(l)	I		

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APPENDIX VI. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX
ACCEPTANCE TESTING SPECIFICATIONS

PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	(5)	I		
	F.	I		
	G.	I		
	H.	I		
	I	I		
	J.(1)	I		
	(2)	I		
3.2.3.8	E/G BATT. VOLTAGE ESCI. [5.9			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B.	I		
	C.	I		
	D.(1)	I		
	(2)	I		
	E.	I		
3.2.3.9	E/G XFER SW POS ESCI. [5.10]			
	(1)	I		
	(2)	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.(1)	I		
	(2)	I		
3.2.3.10	E/G OIL PRESSURE ESCI.[5.11]			
	(1)	I		
	(2)	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.2.3.11	E/G FREQUENCY ESCI.[5.12]			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B.(1)	I		
	(2)	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
	J.	I		
3.2.3.12	E/G COOLANT TEMP ESCI.[5.13]			
	(1)	I		
	(2)	I		
	(3)	I		
	A.	I		
	B:(l)	I		

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PARAGRAPH NUMBER	PARAGRAPH TITLE	FACTORY QUALIFICATION	SITE VERIFICATION	REMARKS
	(3)	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.2.4	CONTROL FUNCTION ESCI [2.1.1]			
	1.	I		
	2.	I		
	3.	I		
	4.	I		
	5.	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.3	DATA PROCESSING RESOURCES	I		
3.3.1	COMPUTER HARDWARE RQMTS (SEE SECT. 3.2)	S		
3.3.2	PROGMING RQMTS[3.1.1.2(L)] [3.1.1.2(M)]	I		
3.3.3	DESIGN AND CODING CONSTRNTS			
	A.(1)	I		
	(2)	I		
	B.(1)	I		
	(2)	I		
3.3.4	ELECTROMAGNETIC INTERFERENCE	T	D	
3.4	Documentation	I	I	
3.4.1	Engineering Documentation	I	I	
3.4.2	Software Documentation			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
3.4.3	Interface Control Documentation			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
	(5)	I	I	
	(6)	I	I	
	(7)	I	I	
	(8)	I	I	
3.4.4	Configuration Management Documentation			
	(1)	I	I	

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	(3)	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.2.4	CONTROL FUNCTION ESCI [2.1.1]			
	1.	I		
	2.	I		
	3.	I		
	4.	I		
	5.	I		
	A.	I		
	B.	I		
	C.	I		
	D.	I		
	E.	I		
	F.	I		
	G.	I		
	H.	I		
	I.	I		
3.3	DATA PROCESSING RESOURCES	I		
3.3.1	COMPUTER HARDWARE RQMTS (SEE SECT. 3.2)	S		
3.3.2	PROGMING RQMTS[3.1.1.2(L)] [3.1.1.2(M)]	I		
3.3.3	DESIGN AND CODING CONSTRNTS			
	A.(1)	I		
	(2)	I		
	B.(1)	I		
	(2)	I		
3.3.4	ELECTROMAGNETIC INTERFERENCE	T	D	
3.4	Documentation	I	I	
3.4.1	Engineering Documentation	I	I	
3.4.2	Software Documentation			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
3.4.3	Interface Control Documentation			
	(1)	I	I	
	(2)	I	I	
	(3)	I	I	
	(4)	I	I	
	(5)	I	I	
	(6)	I	I	
	(7)	I	I	
	(8)	I	I	
3.4.4	Configuration Management Documentation			
	(1)	I	I	

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ACRONYM	MEANING
	A
A/C	AIR CONDITIONING
A/D	ANALOG TO DIGITAL
ac	ALTERNATING CURRENT
ACF	AREA CONTROL FACILITY
ADCCP	ADVANCED DATA COMMUNICATIONS CONTROL PROCEDURE
AF	AIRWAY FACILITIES
ASR	AIRPORT SURVEILLANCE RADAR
ASYNC	ASYNCHRONOUS
AWG	AMERICAN WIRE GAGE
	C
°C	DEGREE CELSIUS
CASE	COMMON APPLICATION SERVICE ELEMENTS
CDRL	CONTRACT DELIVERABLE REQUIREMENTS LIST
CI	CONFIGURATION ITEM
CM	CONFIGURATION MANAGEMENT
CMOS	COMPLEMENTARY METAL OXIDE SEMICONDUCTOR
COTS	COMMERCIAL OFF-THE-SHELF
CPU	CENTRAL PROCESSING UNIT
CRT	CATHODE RAY TUBE
CSC	COMPUTER SOFTWARE COMPONENT
CSCI	COMPUTER SOFTWARE CONFIGURATION ITEM
CT	CURRENT TRANSDUCER
	D
dc	DIRECT CURRENT
DCE	DATA COMMUNICATION EQUIPMENT
DCN	DESIGN CHANGE NOTICE
DPDT	DOUBLE POLE, DOUBLE THROW
DRR	DEPLOYMENT READINESS REVIEW
DTE	DATA TERMINAL EQUIPMENT
DT&E	DEVELOPMENTAL TESTING AND EVALUATION
	E
E/G	ENGINE GENERATOR
EIA	ELECTRONIC INDUSTRIES ASSOCIATION
EICD	ERMS INTERFACE CONTROL DOCUMENT
EIIN	ERMS INTERFACE IDENTIFICATION NUMBER
EIRD	ERMS INTERFACE REQUIREMENTS DOCUMENT
EMI	ELECTROMAGNETIC INTERFERENCE
ERLL	EXTENDED RELAY LADDER LOGIC
ERMS	ENVIRONMENTAL REMOTE MONITORING SUBSYSTEM
ESCI	ERMS SENSOR/CONTROLLER CONFIGURATION ITEM
ESCS	ENGINE STOP CONTROL SWITCH
ETE	END-TO-END

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ETE	END-TO-END

MPSH	MAINTENANCE PROCESSOR SUBSYSTEM-HARDWARE
MPSSd	MAINTENANCE PROCESSOR SUBSYSTEM-SOFTWARE
MS	MILLISECOND
MS-DOS	MICROSOFT-DISK OPERATING SYSTEM
MTBF	MEAN TIME BETWEEN FAILURE
MTTR	MEAN TIME TO RESTORE

N

NAILS	NAS INTEGRATED LOGISTICS SUPPORT
NAS	NATIONAL AIRSPACE SYSTEM
N.C.	NORMALLY CLOSED
NCP	NAS CHANGE PROPOSAL
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
N.O.	NORMALLY OPEN
NVRAM	NONVOLATILE RAM

0

OAT	OUTSIDE AIR TEMPERATURE
OLX	AUXILIARY PILOT RELAY
OSI	OPEN SYSTEMS INTERFACE
OT&E	OPERATIONAL TESTING AND EVALUATION

P

PC	PERSONAL COMPUTER
PLC	PROGRAMMABLE LOGIC CONTROLLER
PMDT	PORTABLE MAINTENANCE DATA TERMINAL
PMDTH	PORTABLE MAINTENANCE DATA TERMINAL-HARDWARE
PMDTS	PORTABLE MAINTENANCE DATA TERMINAL-SOFTWARE
PROM	PROGRAMMABLE READ ONLY MEMORY
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH - GAUGE
PTD	PROVISIONING TECHNICAL DOCUMENTATION

Q

QATP	QUALIFICATION AND ACCEPTANCE TEST PLAN
QC	QUALITY CONTROL
QTP	QUALIFICATION TEST PLAN

R

R&D	RESEARCH AND DEVELOPMENT
RAM	RANDOM ACCESS MEMORY
RCE	RADIO CONTROL EQUIPMENT
RFI	RADIO FREQUENCY INTERFERENCE
RLA	REPAIR LEVEL ANALYSIS
RLL	RELAY LADDER LOGIC
RMA	RELIABILITY, MAINTAINABILITY, AVAILABILITY
RMM	REMOTE MAINTENANCE MONITORING
RMMS	REMOTE MAINTENANCE MONITORING SUBSYSTEM
RMS	REMOTE MAINTENANCE SUBSYSTEM
RMSC	REMOTE MONITORING SUBSYSTEM CONCENTRATOR

MPSH	MAINTENANCE PROCESSOR SUBSYSTEM-HARDWARE
MPSSd	MAINTENANCE PROCESSOR SUBSYSTEM-SOFTWARE
MS	MILLISECOND
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RMMS	REMOTE MAINTENANCE MONITORING SUBSYSTEM
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ERMS SPECIFICATION SUBJECT INDEX

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